Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

0072672

APR 10 2007

07-SED-0199

Ms. Jane A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Blvd.
Richland, Washington 99354

Dear Ms. Hedges:

TRANSMITTAL OF NONRADIOACTIVE AIR EMISSIONS NOTICE OF CONSTRUCTION (NOC) THE 200 AREA EFFLUENT TREATMENT FACILITY-PROPOSED ADDITION OF THE SOLIDIFICATION TREATMENT UNIT

The purpose of this letter is to transmit the subject NOC application (Enclosure 1) which is required by Chapter 173-460 Washington Administrative Code (WAC). In accordance with Chapter 173-401 WAC, this letter also transmits the Hanford Site Air Operating Permit, Notification of Off-Permit Change (Enclosure 2), to the State of Washington Department of Ecology (Ecology), consistent with Ecology's role as lead for the Hanford Site Air Operating Permit. If you have any questions, please contact me, or your staff my contact Doug S. Shoop, Assistant Manager for Safety and Engineering, on (509) 376-0108.

Sincerely,

for Keith A. Klein
Manager

SED:MFJ

Enclosures

cc: See page 2

RECEIVED
APR 13 2007
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Administrative Record (file: 200 Area Effluent Treatment Facility (ETF)/Hanford Site Air Operating Permit)
Environmental Portal, LMSI, A3-95

ENCLOSURE 1

DOE/RL-2006-71, Revision 0
Nonradioactive Air Emissions Notice of Construction for the 200 Area Effluent Treatment Facility-Proposed Addition of the Solidification Treatment Unit

DOE/RL-2006-71
Revision 0

Nonradioactive Air Emissions Notice of Construction for the 200 Area Effluent Treatment Facility – Proposed Addition of the Solidification Treatment Unit

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

DOE/RL-2006-71
Revision 0

Nonradioactive Air Emissions Notice of Construction for the 200 Area Effluent Treatment Facility – Proposed Addition of the Solidification Treatment Unit

Date Published
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Prepared for the U.S. Department of Energy
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FIGURES

TABLES

TERMS

AOP	*Hanford Air Operating Permit*
ASIL	acceptable source impact level
BACT	best available control technology
Ecology	Washington State Department of Ecology
ETF	200 Area Effluent Treatment Facility
HEPA	high-efficiency particulate air
NOC	notice of construction
PSD	prevention of significant deterioration
PUREX	Plutonium Uranium Extraction (Facility)
RACT	reasonably available control technology
RO	reverse osmosis
SQER	small quantity emission rates
STU	Solidification Treatment Unit
SWRT	Secondary Waste Receiving Tank
T-BACT	best available control technology for toxics
VOG	vessel off-gas
WAC	*Washington Administrative Code*
WDOH	Washington State Department of Health

METRIC CONVERSION CHART

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.03937	inches
inches	2.54	centimeters	centimeters	0.393701	inches
feet	0.3048	meters	meters	3.28084	feet
yards	0.9144	meters	meters	1.0936	yards
miles (statute)	1.60934	kilometers	kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres	0.404687	hectares	hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.34952	grams	grams	0.035274	ounces (avoir)
pounds	0.45359237	kilograms	kilograms	2.204623	pounds (avoir)
tons (short)	0.9071847	tons (metric)	tons (metric)	1.1023	tons (short)
Volume			**Volume**		
ounces (U.S., liquid)	29.57353	milliliters	milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	liters	liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	liters	liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch	6.894757	kilopascals	kilopascals	0.14504	pounds per square inch

06/2001

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Third Ed., 1993, Professional Publications, Inc., Belmont, California.

NONRADIOACTIVE AIR EMISSIONS NOTICE OF CONSTRUCTION FOR THE 200 AREA EFFLUENT TREATMENT FACILITY – PROPOSED ADDITION OF THE SOLIDIFICATION TREATMENT UNIT

1.0 INTRODUCTION

The 200 Area Effluent Treatment Facility (ETF) is a wastewater treatment system designed to treat dilute liquid waste streams generated on the Hanford Site by removing organic, inorganic, and radioactive contaminants. The treated effluent is discharged to the State Approved Land Disposal Site, while the residual contaminated water is evaporated and dried to a powder for disposal. The proposed Solidification Treatment Unit (STU) will be an addition to the ETF process to take the evaporated waste stream and solidify it using cementitious materials. The STU will produce 3 foot by 3 foot by 3 foot cement blocks enclosed in bags for disposal. The STU will include dry material handling equipment, a mixer tank, and a rigid frame unit for filling the bags. The STU equipment will be located in an annex adjacent to the existing ETF building (2025E). Because of the design and location of the STU, a separate stack will be included to vent the mixer tank and the annex building. This notice of construction (NOC) requests Washington State Department of Ecology (Ecology) approval to construct and operate this new emission source.

The emissions from the existing ETF stack (296-E-001) are described in two previous NOC applications: *Notice for Approval to Construct the 242-A Evaporator/PUREX Plan Process Effluent Treatment Facility* (DOE/RL-92-69) and *Nonradioactive Air Emissions Modification to the Notice of Construction for the 200 Area Effluent Treatment Facility* (DOE/RL-96-78). Ecology issued approvals NOC-93-3 (Ecology 1993) and 96NW-1-301 (Ecology 1996). The emissions from the existing ETF stack will not increase or change composition as a result of the addition of the STU process.

2.0 PROJECT DESCRIPTION

A detailed description of the ETF process is found in the original NOC application (DOE/RL-92-69). To summarize, the primary treatment train provides for feed storage, suspended solids removal, ultraviolet/oxidation with hydrogen peroxide, pH adjustment, degasification, reverse osmosis (RO), ion-exchange polishing, final pH adjustment, and effluent storage. A secondary treatment train provides evaporation of treatment solutions (e.g., RO reject and resin regenerating solutions). The concentrated liquid from the evaporator (called concentrate or brine) is dried to a powder in the Thin Film Dryer. All of the existing ETF process components contain vents that tie into the ETF vessel off-gas (VOG) system.

In the proposed modification, the concentrate from the evaporator may be dried to a powder in the existing Thin Film Dryer, as described previously, or it may be converted to concrete in the STU. The STU will consist of the following units:

- Three Storage Silos for the dry cementitious materials used in the solidification process. These silos will be located outside the STU annex and vent to the atmosphere. Each silo will have a Weigh Hopper for measuring the proper quantity of each dry material to add to the Feed Hopper. Each Weigh Hopper will vent to its respective Storage Silo.
- A Feed Hopper that will receive dry materials from the Weigh Hoppers. The Feed Hopper will be located inside the STU annex and will meter the blended dry material into the Grout Mixer using a

rotary valve. The Feed Hopper will have a vacuum pump to receive dry material from the Weigh Hoppers. The Feed Hopper and vacuum pumps will vent to the new STU Exhaust Stack.

- A Grout Mixer vessel where a batch of the liquid waste (concentrate) and the dry materials will be combined. The Grout Mixer will be located in the STU annex and vent to the new STU Exhaust Stack.

- A containment bag placed below the Grout Mixer that will receive the cemented waste via an enclosed chute. The bag consists of an inner polyvinyl chloride layer for containment and an outer polypropylene layer for lifting. The reinforced bags will be designed to meet U.S. Department of Transportation requirements for shipment of radioactive materials. The bag will sit in a 3 foot by 3 foot by 3 foot rigid steel frame, with hinged sides, on a loading cart. The bag will have a polyvinyl chloride chute which connects to the Grout Mixer discharge chute. The discharge chute will have a vent line which vents the containment bag to the new STU Exhaust Stack.

A batch of the dry materials and the waste will mix in the Grout Mixer for about 30 minutes before a slide valve is opened and the cemented waste drops into the containment bag. The bag will then be closed per the manufacturer's instructions where it connects to the chute. The loading cart with the containment bag will be moved away from the mixer. After the cement has set sufficiently, the sides of the steel loading frame will be lowered and the waste block in the containment bag lifted off the loading cart using an overhead crane. The blocks will be stored until shipment to the disposal site.

2.1 EMISSIONS

Location/physical dimensions, flowrates/temperatures, and gas composition of all emissions.

The emission points will be the dry material Storage Silo vents and the STU Exhaust Stack located on the Hanford Site (Figure 1).

2.1.1 Storage Silo Vents

The Storage Silos will be filled with dry materials by connecting a supply truck to a transfer line and pressurizing the truck with compressed air. During processing, small volumes of compressed air will also used to improve gravity flow of dry material from each Storage Silo into its Weigh Hopper. The dry materials in the Weigh Hoppers will be transferred to the Feed Hopper by vacuum.

Table 1. Dry Material Storage and Operation Flow Rates.

Source	Activity	Frequency	Exhaust flow rate, cubic feet per minute [cubic meters per minute]
Storage Silos (each silo)	Filling from pressurized truck	Once a week (< 2 hours per filling)	600 [17]
	Storing		passively vented
	Discharge by gravity	8 times per day	passively vented
Weigh Hoppers (each hopper)	Filling by gravity	8 times per day	5 [0.14]
	Storing		passively vented
	Discharge by vacuum	8 times per day	passively vented
Feed Hopper	Filling by vacuum	8 times per day	See Table 2*
	Storing		See Table 2*
	Discharging by gravity to grout mixer	8 times per day	See Table 2*

* The airflow during these transfers discharges to the STU stack.

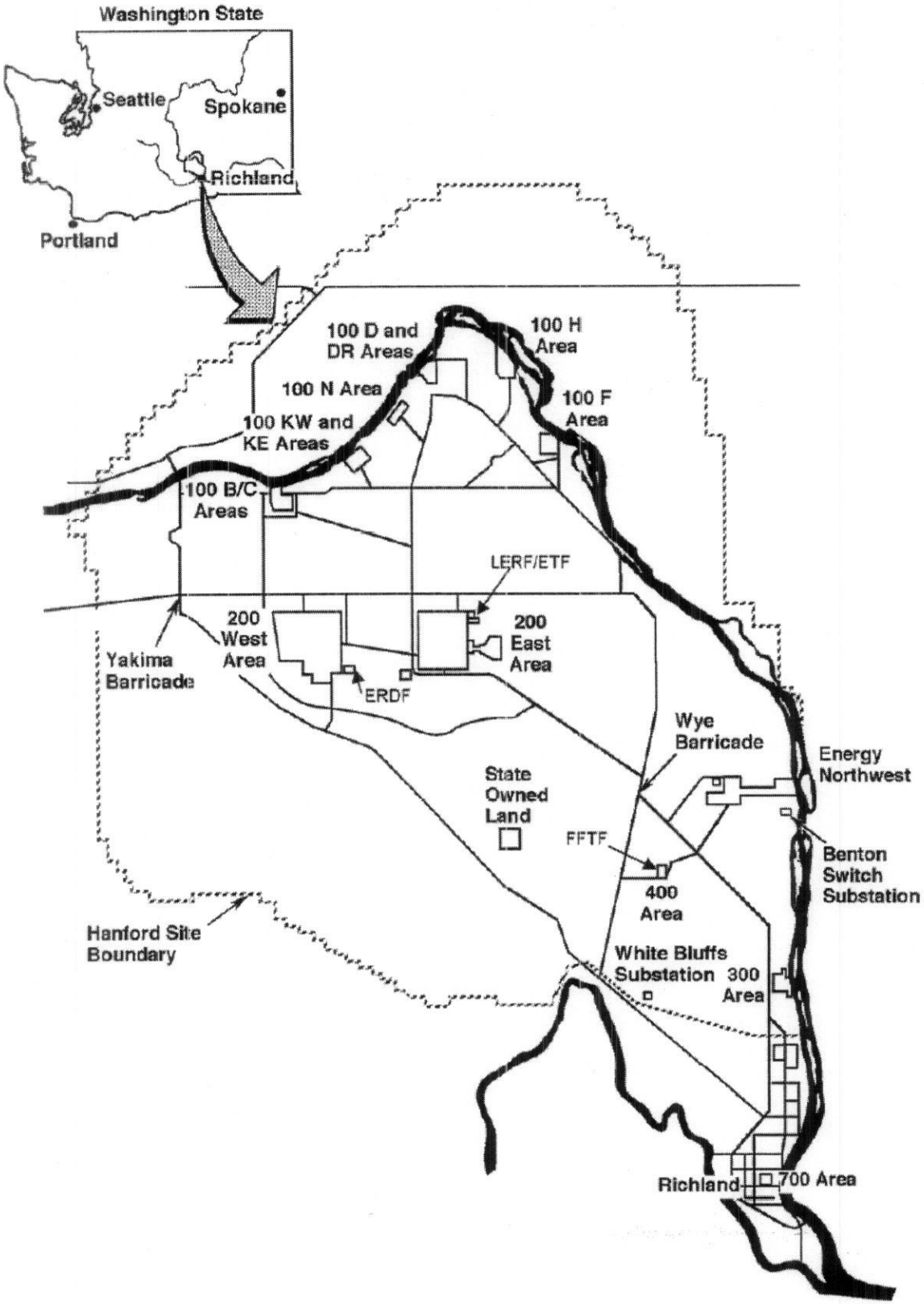

Figure 1. Hanford Site.

Each of the three silos will be vented to the atmosphere through filtration units located on the top of each silo. When the filters are laden with solids, pulses of compressed air will be applied opposite to the normal flow, causing the solids to drop back into the silos. The vents for the dry material silo will be 41 feet (12.5 meters) above ground level.

A variety of dry material compositions may be used in the feed. The typical mix will be portland cement, blast furnace slag, and hydrated lime. Typical constituents will be, but are not limit to, the following:

- Aluminum oxide
- Calcium carbonate
- Calcium hydroxide
- Calcium oxide
- Iron oxide
- Magnesium hydroxide
- Magnesium oxide
- Manganese oxide
- Potassium oxide
- Silicon oxide
- Sodium oxide
- Titanium oxide

The toxic air pollutants in these materials are: calcium oxide, calcium hydroxide, and manganese oxide.

2.1.2 STU Exhaust Stack

The STU exhaust stack and ventilation train will exhaust filtered air from the Feed Hopper, Grout Mixer/discharge chute, and the STU annex building. It will also intermittently exhaust air from the vacuum pump that will batch transfer dry material from the Weigh Hoppers to the Feed Hopper.

The ventilation system will consist of two exhaust trains, one in service and one backup. Each train will have a prefilter, two high-efficiency particulate air (HEPA) filters arranged in series, and an exhauster. The trains will exhaust into the stack, which will be 50 feet (15 meters) above ground level. The stack flows are expected to be:

Table 2. STU Exhaust Stack Flow Rates.

Source	Activity	Frequency	Exhaust flow rate, cubic feet per minute [cubic meters per minute]
Feed Hopper	Filling by vacuum	8 times per day	150 [4.2]
	Storing		0
	Discharge by gravity to grout mixer	8 times per day	0
Grout Mixer/ Discharge Chute	Filling/mixing/discharging	Continuous	50 [1.4]
Building Ventilation		Continuous	5950 [168]
		Total	6000 [170]
		Total (during vacuum transfers)	6150 [174]

The ventilation stream from the primary source of toxic emissions, the Grout Mixer/discharge chute will pass through a prefilter and HEPA filter before discharging into the STU exhaust train.

The ETF was designed to treat wastewater with a variety of organic and inorganic constituents. The NOC applications for the ETF (DOE/RL-92-69 and DOE/RL-96-78) provide the makeup of some typical waste

streams, such as 242-A Evaporator process condensate and UP-1 groundwater. The constituents are listed in Table 3. Two Hanford Facility NOC Revision Forms, approved by Ecology in 2001 (DOE 2001), revised the tables in the NOC application (DOE/RL-96-78) to provide a complete list of toxic air pollutant constituents that may be processed at the ETF.

2.2 DIFFUSE/FUGITIVE SOURCES

The only potential source of unfiltered releases from the STU will be from the solidified cement blocks. These blocks are enclosed in polyvinyl chloride containment bags that meet U.S. Department of Transportation specifications for shipment of radioactive materials; however, there is the possibility some ammonia may leak or diffuse through the closed bags and produce a detectable odor.

2.3 PROCESS FLOW DIAGRAMS

Process flow diagrams of each emission unit.

Figures 2, 3, and 4 show flow diagrams of the STU process and ventilation systems.

3.0 CONTROL EQUIPMENT DESCRIPTION

Control equipment description and reference to flow diagrams.

Emissions from the STU Exhaust Stack will be controlled by two testable stages of HEPA filters on the STU exhaust ventilation trains. The Grout Mixer/discharge chute passes through a HEPA filter before entering the ventilation train HEPA filters. The radioactive air emissions are regulated under *Washington Administrative Code* (WAC) 246-247.

Each dry material Storage Silo will have a standard industrial filtration system consisting of cartridge or bag (sock) filters, to prevent emission of dry material dusts.

Operations at STU will use this control equipment, resulting in low levels of emission of toxic air pollutants. These emissions, summarized in Section 5.0, will be below the small quantity emission rates (SQER) described in WAC 173-460-080. Therefore, no additional control equipment is proposed.

3.1 CONTROL EQUIPMENT EFFICIENCIES

Control equipment efficiencies and operational requirements.

Each stage of HEPA filtration on the STU exhaust system will have a minimum efficiency of 99.95 percent for particulates and aerosols with a median diameter of 0.7 micron. These are regulated by the Washington State Department of Health (WDOH). HEPA filters will be procured using *Procurement Specification for Standard, Nuclear Grade, High Efficiency Particulate Air (HEPA) Filters*, HNF-S-0552 (FH 2005). This procurement specification ensures that HEPA filters meet the requirements of Section FC in ASME/ANSI AG-1. Each Storage Silo will have industrial cartridge or bag (sock) filters for dust control. These will be operated and maintained per the manufacturer's recommendations.

3.2 RACT

Demonstrate compliance with Reasonably Achievable Control Technology (RACT)

Estimated criteria pollutant emissions (Table 3) will not exceed 100 tons/year of any regulated pollutant and are therefore not subject to review under Prevention of Significant Deteriorations (PSD) provisions of WAC 173-400-700 *et seq.* Emissions of criteria pollutants do not exceed *Emission Thresholds* of WAC 173-400-030(27) nor exemption levels of WAC 173-400-110(5)(d) and are therefore exempt from criteria pollutant New Source Review. Therefore RACT is the prevailing standard of control for this source. The industrial and HEPA filtration planned for this source, in combination with the fact that there are no open air conveyances (as described in section 5.1) are appropriate for the expected emissions (primarily particulate) and satisfy the RACT requirement..

Table 3. STU Criteria Pollutant Emissions.

Criteria Pollutant	Emission from STU, lbs/yr [tons/yr]	Criteria for exemption, lbs/yr [tons/yr]	Comment
Particulate Matter (PM)	27 [0.013]	2,500 [1.25]	
Fine Particulate (PM10)	14 [0.0072]	1,500 [0.75]	
Sulfur Oxides	0.87 [2.8E-04]	4,000 [2.0]	Emissions as SO4-, SO3
Nitrogen Oxides	0.55 [2.8E-04]	4,000 [2.0]	Emissions as NO3-, NO2-
Volatile Organic Compounds	0.018 [9.2E-06]	4,000 [2.0]	
Carbon Monoxide	0	10,000 [5.0]	
Lead	1.7E-06 [8.5E-10]	10 [0.005]	
Ozone Depleting Substances	0	2,000 [1.0]	
Toxic Air Pollutants	See Table 4	WAC 173-460	

Ammonia is expected to emit from the Grout Mixer tank and containment bag due to an increase in pH following addition of the dry cement materials. These emissions will be administratively controlled to below the SQER of 2.0 pounds per hour by limiting the quantity of ammonia in each batch in the Grout Mixer (see Section 3.3).

Trace organic toxic air pollutant emissions are anticipated to be in gaseous form. The toxic air pollutants are anticipated to be well below their SQER, so implementation of best available control technology for toxics (T-BACT) is not warranted.

All inorganic toxic air pollutant emissions except ammonia are anticipated to be in dust or mist (aerosol) form. T-BACT for these materials will utilize filtration. The STU exhaust will have HEPA filtration, which are required controls for NOC coverage and regulated by the WDOH. The dry material Storage Silos will have standard industrial filtration.

In conclusion, no additional controls are proposed or warranted in satisfying BACT, T-BACT, and reasonably available control technology (RACT) for operation of the STU. Ammonia emissions will be administratively controlled as described in Section 3.3.

3.3 PROPOSED CRITERIA/TOXIC EMISSION CONTROLS

Certain wastewaters processed at ETF, such as 242-A Evaporator process condensate, contain ammonia. These wastewaters are acidified in the ETF process to maintain the ammonia in solution as ammonium

sulfate/ammonium nitrate. When the dry cement materials are added to this waste in the Grout Mixer, the pH will rise sharply, converting the ammonium sulfate/ammonium nitrate into dissolved ammonia gas. A percentage of the gas will emit from the Grout Mixer and the containment bag before it is closed. Experimental results, presented in *Effluent Treatment Facility Waste Stream Monolith Testing Phase II* (CHG 2006), shows emissions will be highest during the first 20 minutes, and 5.2% of ammonia will emit during the first hour (see Figure 6).

The quantity of ammonia in the Grout Mixer will be controlled to less than 16 kilograms (35 pounds) by limiting the ammonia concentration and/or wastewater volume in each batch in the Grout Mixer.

The ammonia emissions will stop when the containment bag is closed since the containment bag is sealed. However, some ammonia odor may be detectable as discussed in Section 2.2. Filling the Grout Mixer/containment bags is a batch process which will take less than one hour. By controlling the quantity of ammonia in each batch in the Grout Mixer to less than or equal to 16 kilograms (35 pounds), the emission will be 0.052 x 35 pounds = 1.8 pounds per hour. This is below the SQER of 2 pounds per hour in WAC 173-460-080(2)(e). At full production, a total of eight batches can be processed each day. This includes the time to fill the grout mixer/containment bags plus the time needed for solidification and preparation. Therefore the total annual potential to emit for this process is approximately 5,400 pounds [see Table 4 (SQER = 17,500 pounds)] without constraining operations (i.e., number of batches). Since only a portion of the wastewaters treated at ETF contain significant amounts of ammonia the actual emissions will be lower.

4.0 AIRBORNE EMISSIONS MONITORING SYSTEMS

The follow sections address airborne emission monitoring systems and requirements.

4.1 DESCRIPTION

Provide description and capability of monitor/sampling systems, if required.

The projected emission levels of organic and inorganic pollutants regulated by WAC 173-400 and -460 from the STU are so low that the levels are not practical to measure. The emissions of ammonia will be administratively controlled to less than the SQER specified in WAC-173-460, so addition of monitoring or sampling systems is not warranted.

4.2 AIR OPERATING PERMIT REQUIREMENTS

Propose methods to satisfy AOP periodic monitoring requirements.

General standards for all emission units on the Hanford Site are specified in Table 1.2 of Attachment 1 of the *Hanford Air Operating Permit* (AOP), 00-05-006 (Ecology 2006). Requirements specific to the ETF are specified in Table 1.6 of the AOP. The following standards are relevant to the STU:

General standards from AOP Table 1.2:

- Opacity of 20% – Opacity from the STU Exhaust Stack will be handled per Tier 3, which requires maintaining HEPA filters per WDOH requirements in the AOP.

  Opacity from the Storage Silos and Feed Hopper is expected to be undetectable because of filters on the vents. Monitoring will be per Tier 2, which requires weekly visible emission surveys for the first

three months of operation. If negative, quarterly surveys are performed for six months. After one year of no visible emissions, visible emissions surveys will be performed only when emissions are observed or expected. Results of the surveys will be placed in the facility operating record.

- Odor – Monitoring for odor will be based on records of complaint investigations, as discussed in AOP Attachment 1, Section 2.2.

ETF-specific requirements from AOP Table 1.6. These requirements will be extended to the STU:

- Change in proposed control systems – Condition: The Department of Energy will not make any changes to the proposed control systems at STU (i.e., filtration systems) which may result in an increase, or change in the types of air emissions, without first notifying Ecology. Based on the notification, Ecology will make a determination whether a new approval or modification of this final approval order is required. No monitoring requirement or records are specified in the AOP.

- Review of new waste streams – Condition: Any addition of new waste streams that do not meet the new source review exemption in WAC 173-460-040(2)(c), or that have previously unidentified constituents to the facility, requires prior review and approval by Ecology. Monitoring: Analyze each the waste streams to determine if emissions would exceed an SQER or acceptable source impact level (ASIL). Required records: Results of the analysis.

A complete list of constituents was approved by Ecology in 2001 on two Hanford Facility NOC Revision Forms (DOE 2001). These forms revised the tables in the NOC application (DOE/RL-96-78) to provide a complete list of toxic air pollutant constituents that may be processed at the ETF. The same list of constituents will apply to the STU.

5.0 EMISSION ESTIMATION AND AIR IMPACT ANALYSIS

Emission estimates were developed for the STU based on influent waste concentrations to the ETF in the previous NOC applications (DOE/RL-92-69 and DOE/RL-96-78). The original NOC (DOE/RL-92-69) specified criteria/toxic air pollutants for streams from the Plutonium Uranium Extraction (PUREX) facility and the 242-A Evaporator. The PUREX facility was shutdown before the stream was received at ETF; only the 242-A Evaporator stream is included in this NOC. The influent waste concentrations are given in Table 4.

5.1 CRITERIA/TOXIC AIR POLLUTANTS

Estimate of all potential and actual emissions for criteria/toxic air pollutants [based on hours of operation per year, rate of operation, control efficiencies, and a comparison of baseline to proposed emissions (modifications only)].

Emissions estimate were calculated based on a series of unit operations in the secondary treatment train and the STU. For simplicity, all contaminant in the feed to the ETF are assumed to enter the secondary treatment train. Emissions were calculated as follows:

- ETF Evaporator and Concentrate Tanks – Wastewater from the main treatment train is processed through the Evaporator before transfer to STU. Although the Evaporator and Concentrate Tanks are not part of the STU, they were modeled to show that volatile organic constituents evaporate and return to the ETF. For volatile organic constituents, the Evaporator is modeled as a single-stage

evaporation unit using Henry's law of gas-liquid equilibrium. The Evaporator removes from the influent about 97% of the water and greater than 99% of most organic constituents. Appendix A, Table A-1 provides the percent evaporated for each constituent. The water and organics are condensed and returned to the ETF for treatment. Only about 0.2% of the organic in the influent will enter the STU. The inorganic constituents are present in the wastewater as dissolved salts, so none are evaporated. This includes the ammonia, which is present as ammonium nitrate/ammonium sulfate. The concentrated waste (brine) from the Evaporator transfers to the Concentrate Tanks for staging to the Grout Mixer in the STU. Both the Evaporator and the Concentrate Tanks are vented to the ETF exhaust stack, and emissions are included in the existing NOC applications (DOE/RL-92-69 and DOE/RL-96-78).

- Grout Mixer – The concentrated waste will be transferred from the Concentrate Tanks to the Grout Mixer in batches. Volatile organic emissions are modeled based on mass transfer equations provided by EPA for wastewater treatment facilities (EPA 1995). Much of the organics present evaporate because of strong agitation in the mixer. Evaporation rates vary from 20% to 90% depending on the constituent. Appendix A, Table A-1 provides the percent evaporated for each constituent in the mixer.

  In spite of the high evaporation rates in the Grout Mixer, overall organic emissions are low because most of the organic material has already been removed from the wastewater by the Evaporator. Since only a fraction of the volatile organic from the influent even reaches the Grout Mixer, overall emission rates are very low. For example, only 1.3E-03% of the acetone in the influent is emitted. Appendix A, Table A-1 provides the overall percent evaporated for each constituent.

  Inorganic constituent emissions from the Grout Mixer are modeled as aerosols, using a mist density of 10 micrograms of wastewater per cubic meter of vapor in the mixer vent, a value from the previous NOC (DOE/RL-92-69). This is equivalent to 8.9E-05% of each constituent in the wastewater entering the off-gas.

- Grout Mixer Ammonia - Ammonia will emit from the Grout Mixer due to an increase in pH following addition of the dry cement materials. Ammonia emissions are modeled based on experiments performed at Columbia Basin College (CHG 2006). Ammonia was monitored in the off-gas when cement was added to a simulated waste mixture. Emissions started sharply, becoming steady after about 20 minutes (see Figure 5), and remaining constant for the remainder of the test.

  Data from the ammonia test was recorded in grams per cubic meter in the off-gas, with readings taken every second. These units were converted to percentage of the total quantity of ammonia in the batch emitted per second (Figure 5). The data was then graphed as an accumulation over time (Figure 6); thus, the data in Figure 6 is the integration of the data in Figure 5. A linear equation was applied to estimate emissions between 20 minutes to 90 minutes. This curve shows emissions after the first hour to be about 5.2% (Figure 6). Because the initial emission was the highest, emission in subsequent hours would not be expected to exceed 5.2% per hour.

- Off-Gas Systems – The Grout Mixer/containment bag off-gas flow rate is about 50 cubic feet per minute. This combines with the STU building exhaust for a total flowrate of about 6000 cubic feet per minute (Table 2). The STU combined off-gas passes through two HEPA filters before entering the exhaust stack. Each HEPA filter provides a decontamination factor of 2000, equal to 99.95% efficiency, for inorganic mists. The HEPA filters provide no decontamination for organics or ammonia. The stack exhaust concentrations are given in Table 5.

The hourly emission rates for each constituent are based on the percent emitted from a batch in the Grout Mixer. Each batch is expected to take one hour or less. Annual emission rates are based on eight of these batches per day, 365 days per year. Hourly and annual emission rates are given in Table 5.

- Dry Material Handling - Emissions of dry cement materials are modeled based on emission factors provided by EPA for cement batching (EPA 2006). Emissions occur during dry material transfers. Four transfers occur: (1) pneumatic transfers from pressurized supply trucks to the Storage Silos; (2) gravity transfers from the Storage Silos to the Weigh Hoppers; (3) pneumatic transfers (by vacuum) from the Weigh Hoppers to the Feed Hopper; and (4) gravity transfers from the Feed Hopper to the Grout Mixer. Per EPA, emissions from gravity transfers are non-detectable. Emission factors used are for "controlled" activities (i.e., activities inside vessels and piping which are vented through filters). No uncontrolled emissions by open air storage or open air conveyance will occur. EPA provides emission factors for cement and cement supplements. Blast furnace slag and hydrated lime are cement supplements. These emission factors are:

Cement:	0.00099 lbs particulate matter emitted per ton of material loaded
	0.00034 lbs particulate matter (10 micron) emitted per ton of material loaded
Cement supplements:	0.0089 lbs particulate matter emitted per ton of material loaded
	0.0049 lbs particulate matter (10 micron) emitted per ton of material loaded.

Note that each ton of dry material will be pneumatically transferred twice: once from the tanker trucks to the Storage Silos, and again from the Weigh Hoppers to the Feed Hopper. Each batch in the Grout Mixer will contain about 1500 lbs of dry material. Total annual usage is expected to be about 2200 tons or less. A summary of emission modeling results for the Storage Silos is given in Table 5.

5.2 DISPERSION MODELING METHODOLOGY

Dispersion modeling methodology is not applicable to the STU.

5.3 AIR QUALITY MODELING RESULTS

Demonstrate compliance with new source review procedures and requirements for toxic air pollutants addressed under WAC 173-460-030, -040, -050, and -060; Model predicted ambient impacts, as required.

Air quality modeling is not applicable to the STU.

6.0 PROPOSED CONDITIONS AND RESTRICTIONS

Proposed criteria/toxic emission controls are discussed in Section 3.3. Final conditions and restrictions will be provided in the approval order issued by Ecology.

7.0 REFERENCES

CHG, 2006, *Effluent Treatment Facility Waste Stream Monolith Testing Phase II*, RPP-RPT-31077, Rev 0, CH2M HILL Hanford Group, Inc., Richland, WA.

DOE/RL-92-69, *Notice for Approval to Construct the 242-A Evaporator/PUREX Plan Process Effluent Treatment Facility*, U.S., Department of Energy, Richland Operations Office, Richland, WA.

DOE/RL-96-78, *Nonradioactive Air Emissions Modification to the Notice of Construction for the 200 Area Effluent Treatment Facility*, U.S. Department of Energy, Richland Operations Office, Richland, WA.

DOE, 2001, *Hanford Facility NOC Revision Form*, concerning revision of Tables 1 and 2 of DOE/RL-96-78, approved by Ecology on January 26, 2001 (two forms), U.S. Department of Energy, Richland Operations Office, Richland, WA.

Ecology, 1993, *In the Matter of: United States Department of Energy Process Effluent Treatment Facility, Richland Washington – No. NOC-93-3 Approval of NOC Application for Nonradioactive Air Emissions*, NOC-93-3, Washington State Department of Ecology, Olympia, WA.

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Ecology, 2006, *Hanford Site Air Operating Permit*, 00-05-006, Attachment 1, Washington State Department of Ecology, Olympia, WA.

EPA, 1995, *AP-42, Fifth Edition, Volume 1, Chapter 4: Evaporation Loss Sources*, Section 4.3, "Waste Water Collection, Treatment and Storage," www.epa.gov/ttn/chief/ap42/ch04/final/c4s03.pdf, U.S. Environmental Protection Agency, Washington, DC.

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FH, 2005, *Procurement Specification for Standard, Nuclear Grade, High Efficiency Particulate Air (HEPA) Filters (for ASME AG-1 Compliant Filters)*, HNF-S-0552, Fluor Hanford, Inc., Richland, WA.

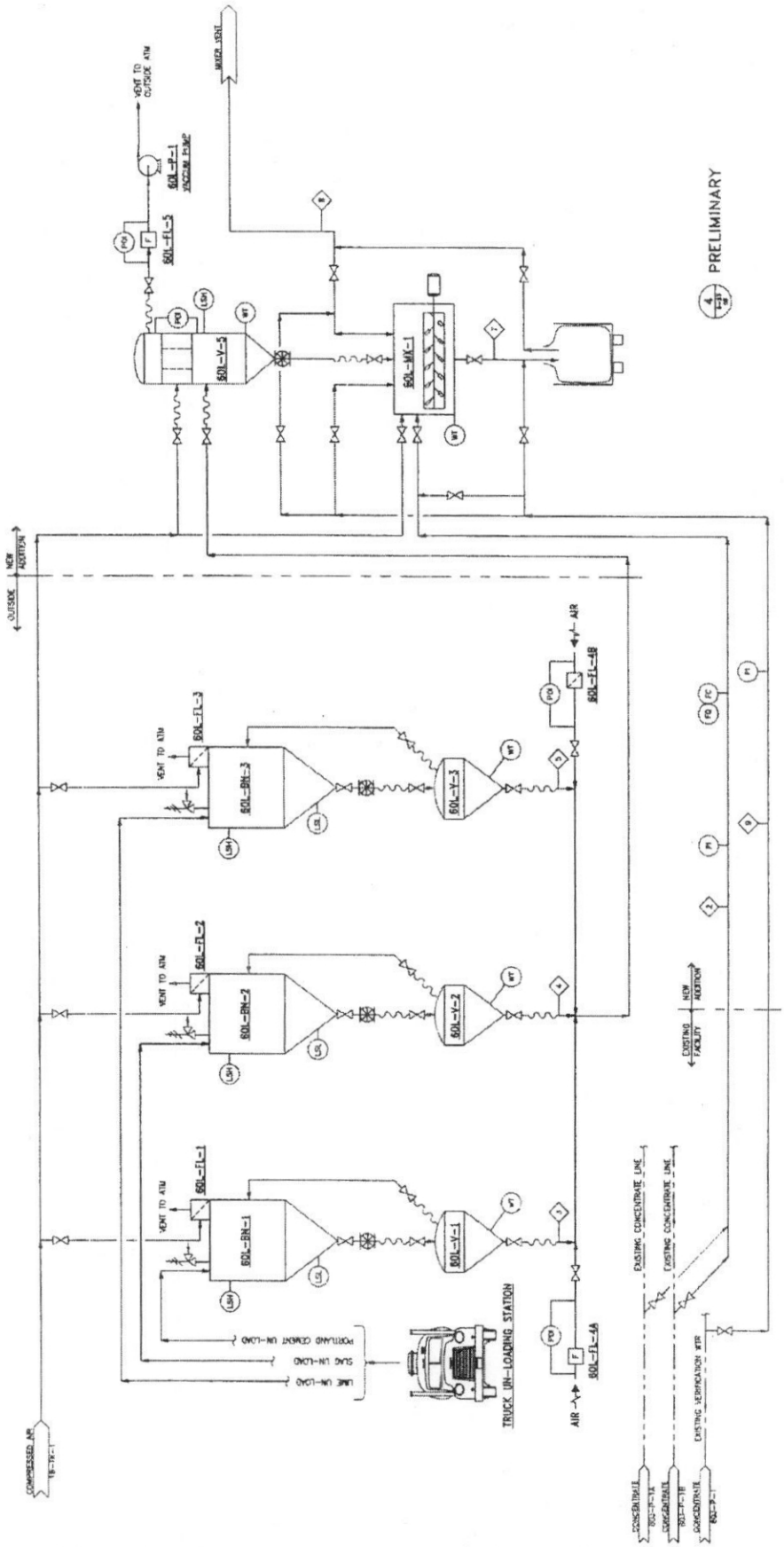

Figure 2. Solidification Treatment Unit Process Flow Diagram.

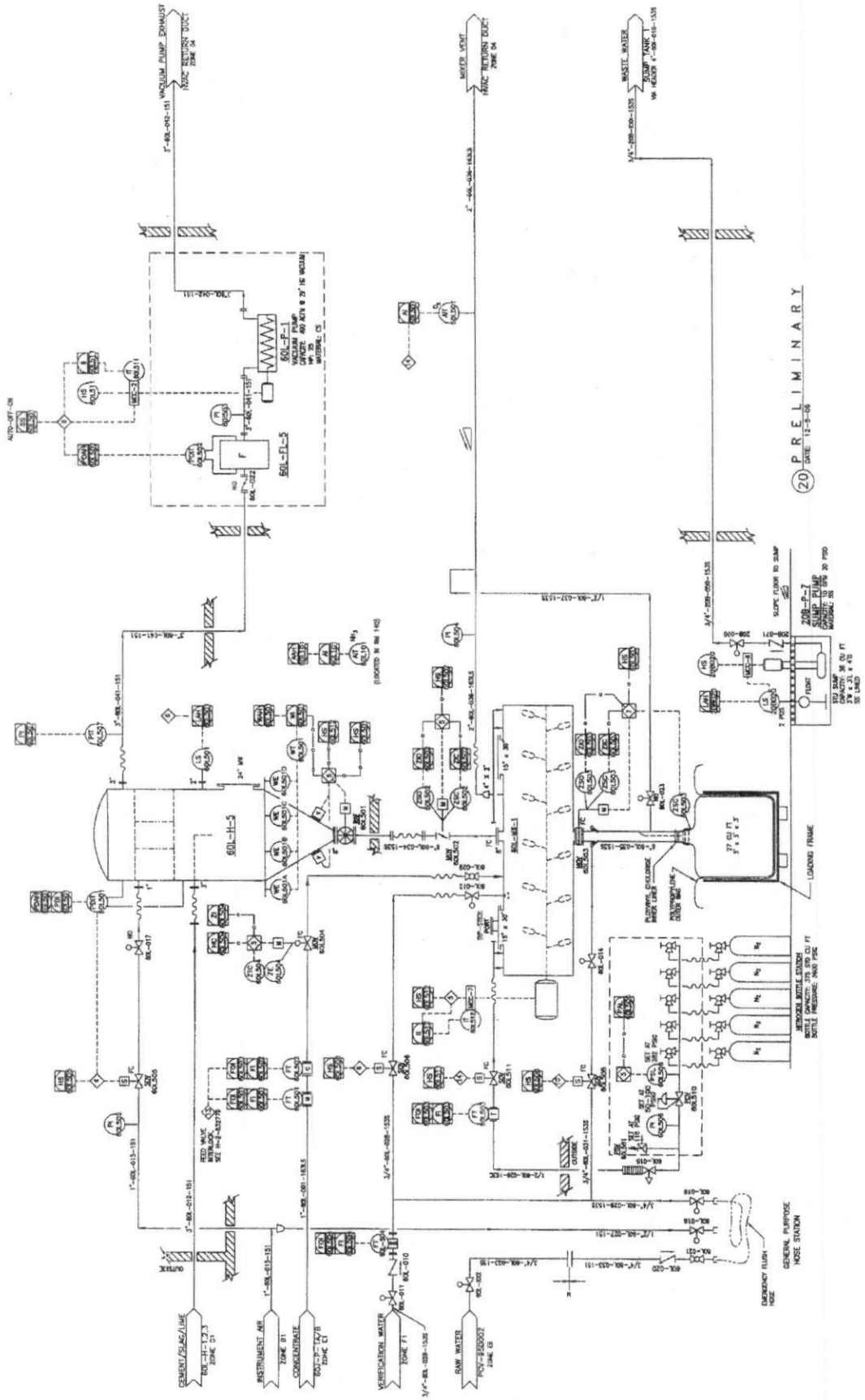

Figure 3. Solidification Treatment Unit Process Ventilation System.

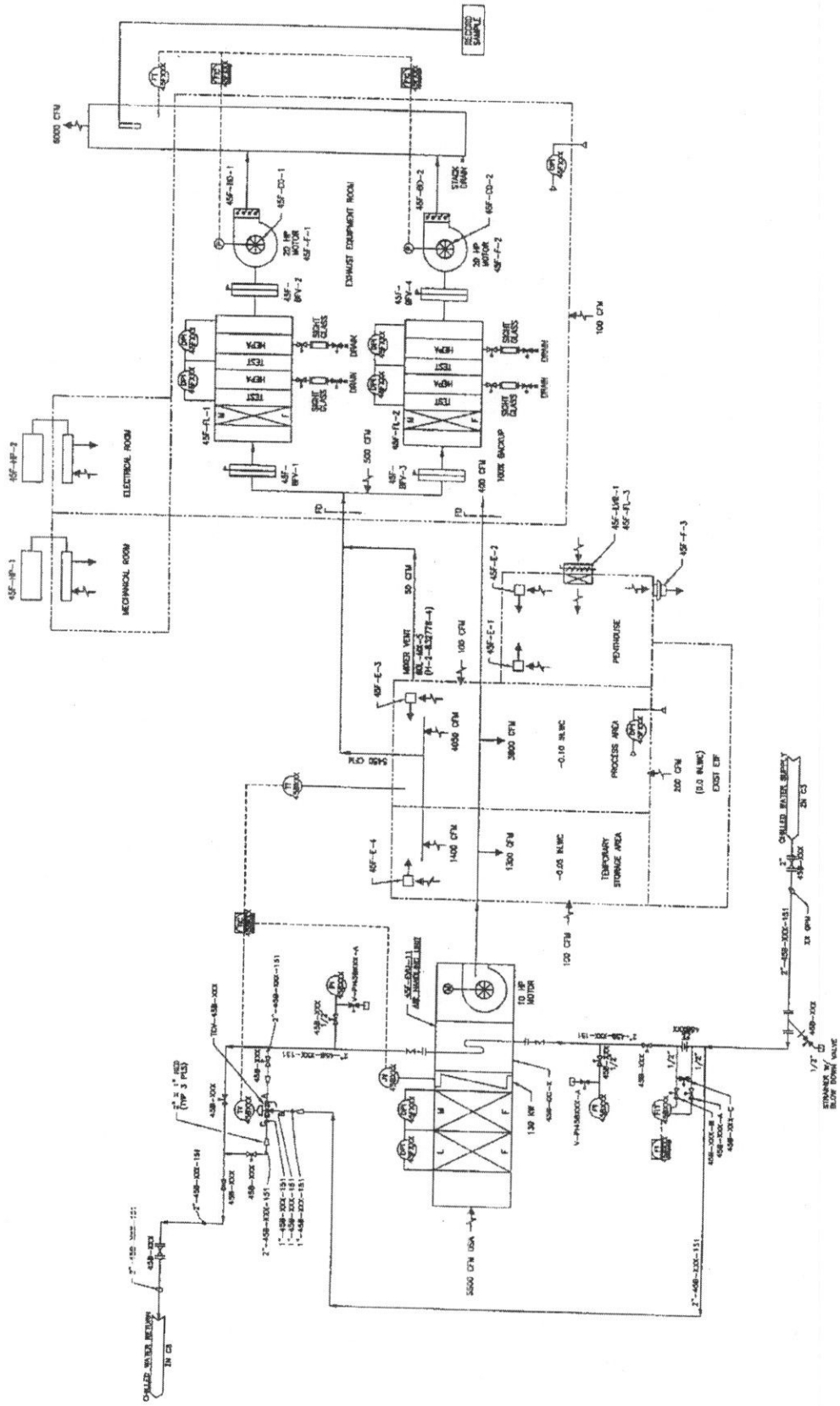

Figure 4. Solidification Treatment Unit Building Ventilation System.

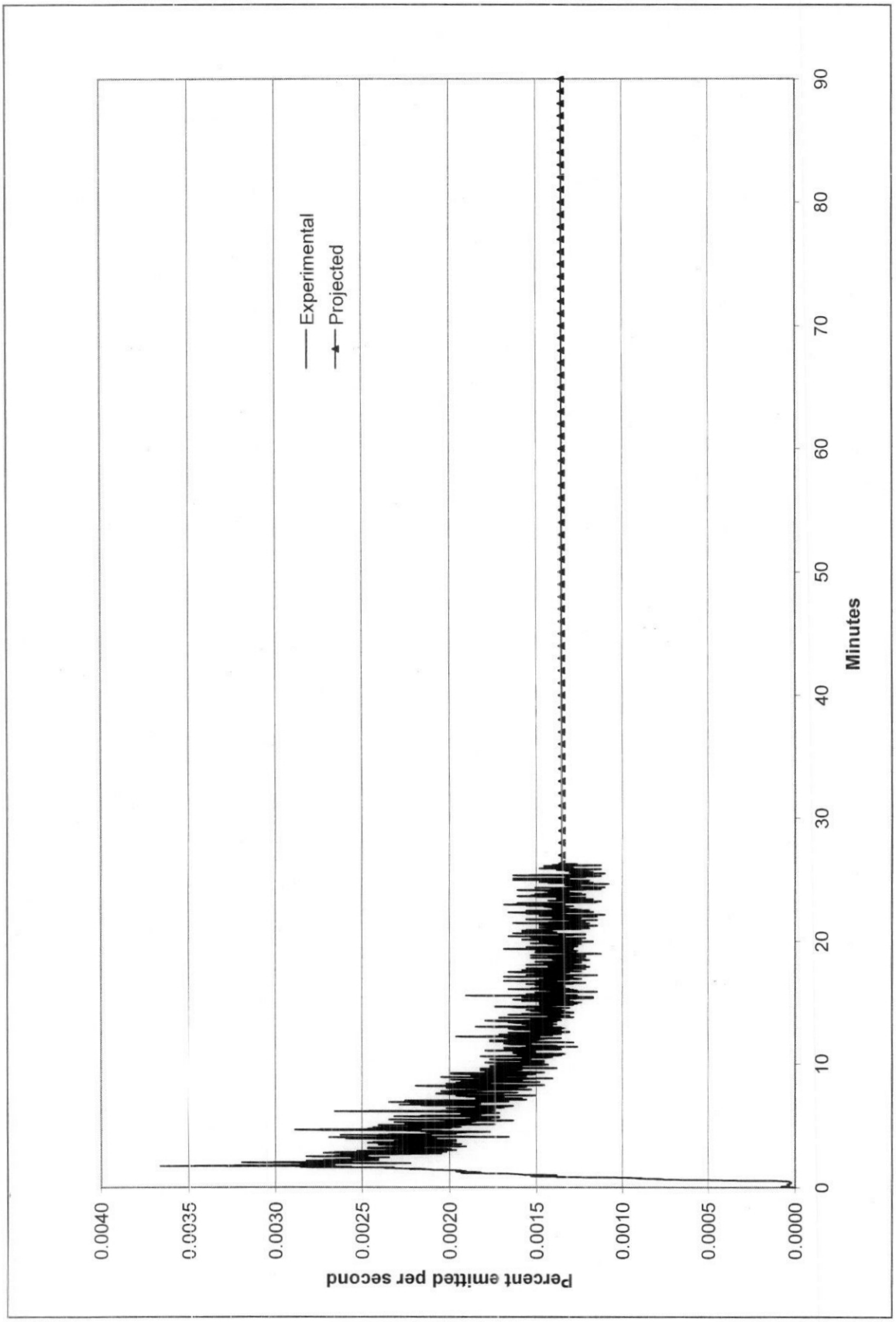

Figure 5. Ammonia Emission during Testing – Rate of Emission.

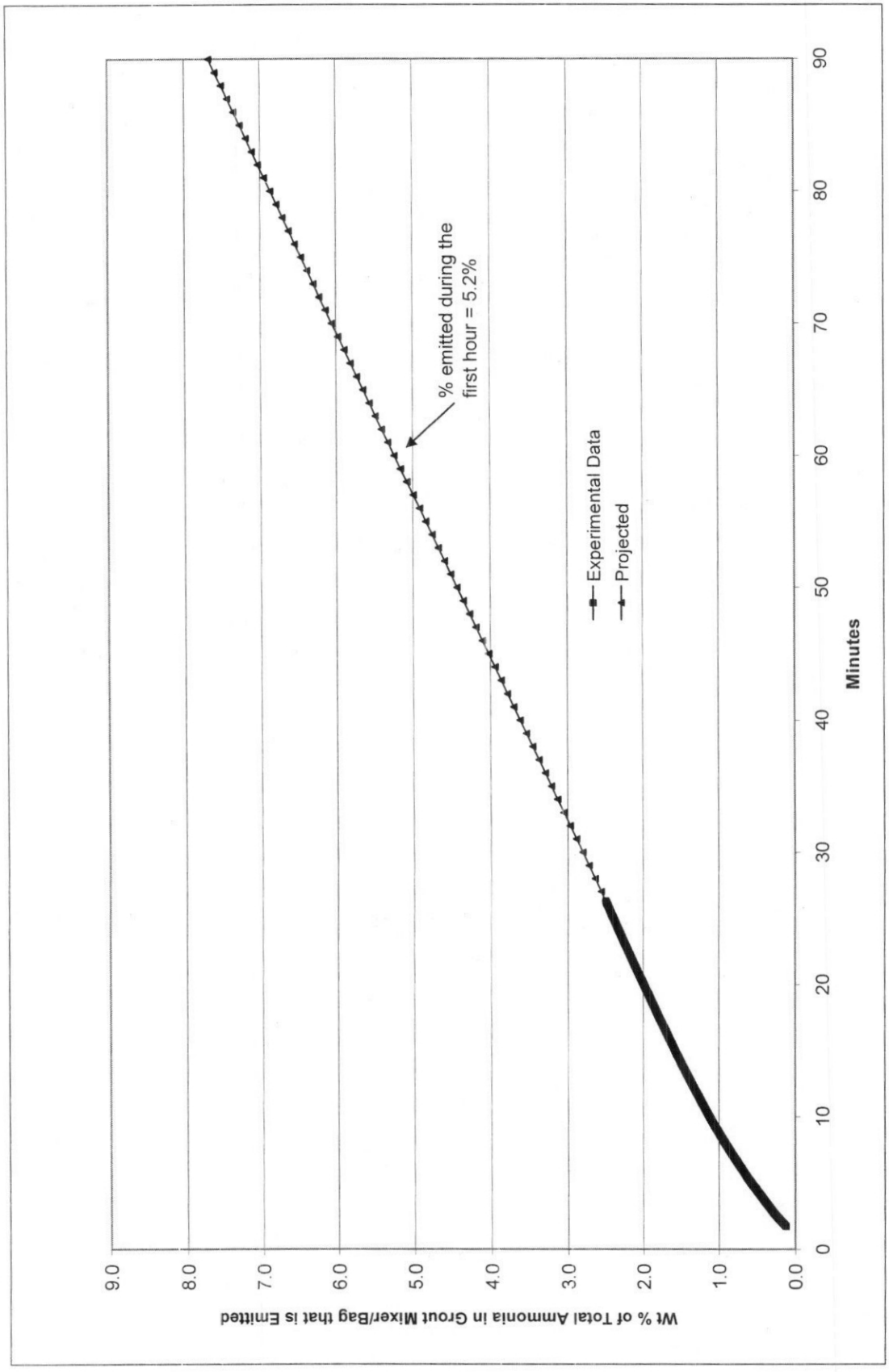

Figure 6. Ammonia Emission during Testing - Total Emitted.

Table 4. Summary of Emission from STU Exhaust.

Constituent	TAP	TAP description	Influent Waste Conc[a] mg/L (ppm)	Emission			WAC 173-460 Level		
				Stack Exhaust Conc. ug/m^3	Emission Rate[b] lb/hr	Emission Rate[c] lb/yr	ASIL Conc. ug/m^3	SQE Rate lb/hr	SQE Rate lb/yr
1,1,1-Trichloroethane (Methyl chloroform)	B		0.00073	2.9E-06	7.1E-11	2.1E-07	6400	5.0	43,748
1,1,2-Trichloroethane	B		0.00031	3.1E-06	7.5E-11	2.2E-07	180	2.6	22,750
1,2-Dichloroethane	B		0.00011	1.5E-06	3.6E-11	1.1E-07	2700	5.0	43,748
1,4-Dichlorobenzene	AI,AII		0.0001	2.1E-06	5.2E-11	1.5E-07	1.5	None	500
1-Butanol (n-Butyl alcohol)	B		11	5.8E-02	1.4E-06	4.2E-03	500	5.0	43,748
2-Butanone (Methyl ethyl ketone)	B		0.053	5.7E-04	1.4E-08	4.1E-05	1000	5.0	43,748
2-Butoxyethanol	B		0.4	2.2E-03	5.4E-08	1.6E-04	400	5.0	43,748
4,4'-DDE	AI,AII		0.00032	1.8E-06	4.3E-11	1.3E-07	0.10	None	20
4,4'-DDT	AI,AII		0.0042	5.0E-05	1.2E-09	3.6E-06	0.01	None	10
Acetone	B		1.0	2.3E-02	5.6E-07	1.6E-03	5900	5.0	43,748
Aldrin	AI,AII		0.0018	2.1E-05	5.2E-10	1.5E-06	0.0002	None	--
Benzene	AI,AII		0.002	1.5E-05	3.6E-10	1.0E-06	0.12	None	20
Carbon tetrachloride	AI,AII		0.44	7.7E-04	1.9E-08	5.5E-05	0.067	None	10
Chloroform	AI,AII		0.014	8.8E-05	2.2E-09	6.3E-06	0.043	None	10
Dieldrin	AI,AII		0.0038	4.5E-05	1.1E-09	3.2E-06	0.00022	None	None
Dodecane	No		100	8.1E-04	2.0E-08	5.8E-05	NA	NA	NA
Endrin	B		0.0044	2.4E-05	6.0E-10	1.7E-06	0.33	0.02	175
Endrin aldehyde	No		0.00067	3.7E-06	9.1E-11	2.6E-07	NA	NA	NA
Ethyl benzene	B		0.0009	6.9E-06	1.7E-10	4.9E-07	1000	5.0	43,748
gamma-BHC (Lindane) (Hexachlorocyclohexane)	AI,AIII		0.0017	1.8E-05	4.4E-10	1.3E-06	1.7	None	500
Heptachlor	AI,AII		0.0017	2.4E-05	6.0E-10	1.7E-06	0.00077	None	None
m-Cresol (Cresol, all isomers)	B		0.074	3.2E-04	7.9E-09	2.3E-05	73	1.20	10,500
Methyl isobutyl ketone	B		0.014	2.0E-04	5.0E-09	1.5E-05	680	5.0	43,748
Methyl n-butyl ketone (2-Hexanone)	B		0.014	2.1E-04	5.1E-09	1.5E-05	67	1.20	10,500
Methyl n-propyl ketone (2-Pentanone)	B		0.0097	1.4E-04	3.5E-09	1.0E-05	2300	5.0	43,748

Table 4. Summary of Emission from STU Exhaust.

Constituent	TAP	TAP description	Influent Waste Conc[a] mg/L (ppm)	Emission			WAC 173-460 Level		
				Stack Exhaust Conc. ug/m^3	Emission Rate[b] lb/hr	Emission Rate[c] lb/yr	ASIL Conc. ug/m^3	SQE Rate lb/hr	SQE Rate lb/yr
Methylene chloride (Dichloromethane)	AI,AII		0.14	8.6E-04	2.1E-08	6.2E-05	0.56	None	50
Pentachlorophenol	AI,AII		0.027	1.5E-04	3.6E-09	1.1E-05	0.33	None	50
Phenol	B		0.84	5.2E-03	1.3E-07	3.7E-04	63	1.20	10,500
Tetrachloroethene (Perchloroethylene)	AI,AII		0.00062	1.2E-06	2.8E-11	8.2E-08	1.1	None	500
Tetradecane	No		0.18	9.1E-06	2.2E-10	6.5E-07	NA	NA	NA
Tetrahydrofuran	B		0.039	3.7E-04	9.0E-09	2.6E-05	2000	5.0	43,748
Toluene	B		0.0006	3.0E-06	7.4E-11	2.2E-07	400	5.0	43,748
Tributyl phosphate	No		30	1.6E-01	4.0E-06	1.2E-02	NA	NA	NA
Trichloroethene	AI,AII		0.008	3.0E-05	7.3E-10	2.1E-06	0.59	None	50
Xylenes (total)	B		0.0016	9.2E-06	2.2E-10	6.6E-07	1500	5.0	43,748
Ammonium	B	as ammonia	511	7.5E+04	1.8	5,400	100	2.0	17,500
Aluminum	B	Al soluble salts as aluminum nitrate	1.33	1.2E-08	1.2E-06	3.4E-03	6.7	0.02	175
Antimony	B	compounds as Sb	0.1	1.1E-10	1.1E-08	3.2E-05	1.7	0.02	175
Barium	B	soluble compounds as Ba	0.3	3.4E-10	3.3E-08	9.6E-05	1.7	0.02	175
Beryllium	AI,AII	Be and compounds	0.0019	3.1E-11	3.1E-09	9.0E-06	0.00042	None	None
Boron	B	as boron trifluoride	0.097	6.8E-10	6.7E-08	2.0E-04	9.3	0.02	175
Bromide	No		0.4	4.5E-10	4.4E-08	1.3E-04	NA	NA	NA
Cadmium	AI,AII	Cd and compounds	0.0072	1.7E-11	1.7E-09	4.9E-06	0.00056	None	None
Calcium	B	as calcium hydroxide	330	7.2E-07	7.0E-05	2.1E-01	17	0.20	1,750
Chloride	No		59	6.6E-08	6.5E-06	1.9E-02	NA	NA	NA
Chromium	AI,AII	hexavalent compounds	0.18	1.0E-09	1.0E-07	3.0E-04	0.000083	None	None
Cobalt	No	(not present as metal dust or fume)	0.005	5.6E-12	5.5E-10	1.6E-06	NA	NA	NA
Copper	B	dusts and mists as Cu	0.79	8.9E-10	8.7E-08	2.5E-04	3.3	0.02	175
Cyanide	B	as CN	0.01	1.1E-11	1.1E-09	3.2E-06	17	0.20	1,750
Fluoride	B	as F	4	4.5E-09	4.4E-07	1.3E-03	8.3	0.02	175
Iron	B	soluble salts as Fe	9.4	1.1E-08	1.0E-06	3.0E-03	3.3	0.02	175

Table 4. Summary of Emission from STU Exhaust.

Constituent	TAP	TAP description	Influent Waste Conc[a] mg/L (ppm)	Emission			WAC 173-460 Level		
				Stack Exhaust Conc, ug/m^3	Emission Rate[b] lb/hr	Emission Rate[c] lb/yr	ASIL Conc, ug/m^3	SQE Rate lb/hr	SQE Rate lb/yr
Lead	AI,AIII	compounds	0.0033	5.9E-12	5.8E-10	1.7E-06	0.50	None	50
Magnesium	No	(not present as a fume)	110	1.2E-07	1.2E-05	3.5E-02	NA	NA	NA
Manganese	B	compounds	0.033	1.2E-10	1.2E-08	3.5E-05	0.40	0.02	175
Mercury	B	inorganic compounds	0.00031	5.6E-13	5.5E-11	1.6E-07	0.33	0.02	175
Nickel	AI,AII	Ni and compounds	0.12	4.2E-10	4.1E-08	1.2E-04	0.0021	None	0.5
Nitrate	B	nitric acid	1700	1.9E-06	1.9E-04	5.5E-01	17	0.20	1,750
Nitrite	No		12	1.3E-08	1.3E-06	3.9E-03	NA	NA	NA
Potassium	B	as potassium hydroxide	13	3.6E-08	3.6E-06	1.0E-02	6.7	0.02	175
Silicon	No	(not present as silicon tetrahydride)	24	2.7E-08	2.7E-06	7.8E-03	NA	NA	NA
Silver	B	soluble compounds as Ag	0.0061	6.8E-12	6.7E-10	2.0E-06	0.033	0.02	175
Sodium	B	as sodium hydroxide	59	1.7E-07	1.6E-05	4.7E-02	6.7	0.02	175
Strontium	No		1.27	1.4E-09	1.4E-07	4.1E-04	NA	NA	NA
Sulfate	B	sulfuric acid	1398	2.0E-06	1.9E-04	5.6E-01	3.3	0.02	175
Uranium	B	soluble and insoluble	16.4	1.8E-08	1.8E-06	5.3E-03	0.67	0.02	175
Vanadium	B	as V2O5	0.04	8.0E-11	7.8E-09	2.3E-05	0.17	0.02	175
Zinc	No	(not present as a fume)	0.33	3.7E-10	3.6E-08	1.1E-04	NA	NA	NA

[a] Influent waste concentrations are the maximum values from:
- Appendix A of *Notice for Approval of Construct the 242-A Evaporator/PUREX Plant Process Effluent Treatment Facility* (DOE/RL-92-69, Rev 0). Concentrations are for 242-A Evaporator process condensate.
- Table 2 of *Nonradioactive Air Emissions Modification to the Notice of Construction for the 200 Area Effluent Treatment Facility* (DOE/RL-96-78, Rev 0.) Influent concentrations are based on the influent being routed directly to Secondary Waste Receiving Tanks (SWRTs).

[b] Hourly emission rate is based on the percent emitted from one Grout Mixer batch. The compound conversion factor in Table B-2 is applied.

[c] Annual emission rate is based one hour operation for each block, 8 blocks per day, 365 day operation.

Table 5. Dry Material Emissions.

Constituent	Total PM		Total PM10		WAC 173-460 Levels	
	Emission Rate, lb/hr[1]	Emission Rate, lb/yr[2]	Emission Rate, lb/hr[1]	Emission Rate, lb/yr[2]	SQE Rate, lb/hr	SQE Rate, lb/yr
Aluminum Oxide, Al2O3	1.3E-03	2.13	7.2E-04	1.16	Not present as a fume	
Calcium Oxide, CaO	3.9E-03	7.02	2.2E-03	3.65	2.0E-02	175
Iron Oxide, Fe2O3	7.4E-05	0.19	4.1E-05	0.09	Not present as a fume	
Magnesium Oxide, MgO	4.5E-04	0.83	2.5E-04	0.45	Not present as a fume	
Manganese Oxide, Mn2O3	4.6E-05	0.07	2.6E-05	0.04	2.0E-02	175
Silicon Dioxide, SiO2	3.1E-03	5.18	1.7E-03	2.78	NA	NA
Titanium Dioxide, TiO2	5.6E-05	0.08	3.1E-05	0.05	NA	NA
Sodium Oxide, Na2O	4.6E-05	0.08	2.6E-05	0.04	NA	NA
Potassium Oxide, K2O	2.8E-05	0.04	1.5E-05	0.02	NA	NA
Calcium Hydroxide, Ca(OH)2	8.8E-03	10.4	4.9E-03	5.70	2.0E-01	1750
Calcium Carbonate, CaCO3	1.6E-04	0.19	8.7E-05	0.10	NA	NA
Sulfite, SO3	1.8E-04	0.31	9.7E-05	0.16	NA	NA
Sulphur, S	7.4E-05	0.11	4.1E-05	0.06	NA	NA
Total vs PM and PM10						
	Total PM		Total PM10		WAC 173-400 Levels	
		Emission Rate, lb/yr[2]		Emission Rate, lb/yr[2]	Total PM, lb/yr	Total PM10, lb/yr
Particulate Matter	NA	26.6	NA	14.3	2500	1500

[1] Since silos would not be filling and discharging at a time, the lb/hr is the maximum value of any one transfer.

[2] Sum of emissions from all silos.

APPENDIX A

SUMMARY OF EMISSION CALCULATIONS

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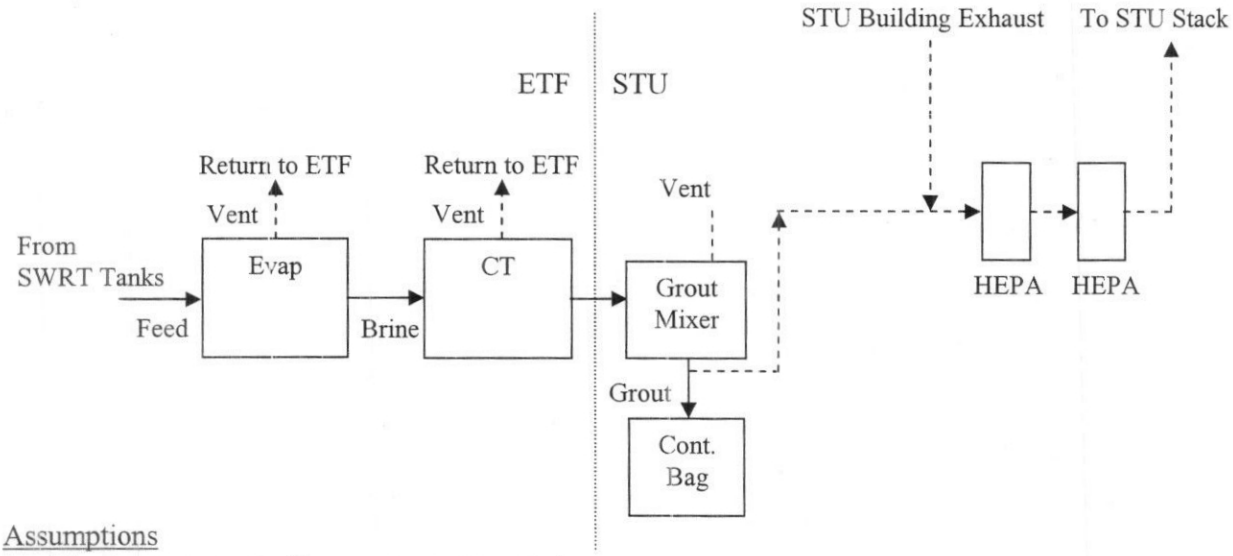
EMISSION CALCULATIONS – OVERVIEW

This section provides an overview of the emission calculations.



Assumptions

- The feed rate to the Evaporator is 22 gal/min
- The brine rate to the Concentrate Tanks is 0.8 gal/min
- The brine is concentrated to 30 weight percent with a density of 1.09 kg/L.
- The maximum volume of brine in a batch in the Grout Mixer is 181 gal.
- The sustained rate of operation is 8 cement blocks per day, 1 hour per block, for a total of 8 hours of operation per day, 365 days per year.
- The stack HEPA filters have efficiencies of 99.95% each (DF is 2000).
- The Grout Mixer/containment bag vent flowrate is 50 ft3/min (at standard conditions)
- The stack vent flowrate is 6000 ft3/min (at standard conditions)

Partition in the ETF Evaporator

Waste from the main treatment train is received in the SWRT tanks and if fed to the Evaporator. The resulting concentrated waste (brine) is transferred to the Concentrate Tanks and the Grout Mixer. The Evaporator evaporates about 97% of the water and >99% of volatile organic compounds. Inorganic compounds are present as dissolved salts, so 0% evaporate. Ammonia is present in the waste as ammonium sulfate/ ammonium nitrate salts, so 0% evaporates.

The percentage of the organics evaporated is calculated based on Henry's law equilibrium calculations. See Part 1 below. The concentration of constituent i in the evaporator brine is:

$$\text{Brine conc of i} = \frac{\text{Evap feed conc of i} * \text{Evap feed flowrate} * \left(1 - \left[\%\ \text{evaporated}/100\right]\right)}{\text{Brine flowrate}}$$

The feed and brine concentrations, and percent evaporated, are given in Table A-1. The water and organics which evaporate are condensed in the vent cooler and return to the ETF. The brine enters the Concentrate Tanks, where a small fraction of the constituents emit to the ETF off-gas. The emissions from the Concentrate Tanks are assumed to be 0%, leaving all the constituents in the brine going to the Grout Mixer.

Emissions from the Grout Mixer

STU operations involve filling the Grout Mixer (GM) with a specific amount of concentrated waste, starting the mixer, adding the dry material, and allowing the material to mix for about 30 minutes. A valve is then opened and the grouted waste drops by gravity into the containment bag (CB). The bag is vented through the discharge chute until it is sealed. The total time from adding the dry material to sealing the bag is expected to take about one hour. The quantity of constituent i emitted is:

Emission rate of i from the GM/CB = Conc of i in GM/CB * Volume of waste in GM/CB * [% emitted/100] * Compound conversion factor of i

For most constituents, the concentration in the Grout Mixer is the same as in the Evaporator Brine. The concentration of calcium, potassium, sodium, hydroxide, and sulfate change due to the addition of dry materials. The percent emitted is calculated three different ways:

- For ammonia, the percent emitted in the first hour, based on experiments conducted at Columbia Basin College, is 5.2%. See Part 2A below.
- For organic compounds, the percent emitted is calculated using a mass transfer model. Emissions vary from 0.011% for tributyl phosphate to 89% for carbon tetrachloride. See Part 2B below.
- For inorganic compounds, the percent emitted, based on mist in the vapor space, is 0.000089% for each constituent. See Part 2C below.

The "Compound conversion factor of i" in the equation above converts the concentration of a constituent to its toxic compound for comparison to the Small Quantity Emission Rate. For example, the emission of sodium is converted to the toxic constituent sodium hydroxide. The compound conversion factor for this is (MW of sodium: 23; MW of hydroxide: 17) equal to: (23 + 17) / 23 = 1.74. Thus, if the emission rate sodium of is 100 mg/hr, the emission rate of sodium hydroxide is 174 mg/hr. For organic constituents, the compound conversion factor is 1.0. The percent emitted from the Grout Mixer for each constituent are given in Table A-1.

Emission from the STU Exhaust

The emission rate from the STU exhaust is the emission rate from the Grout Mixer/containment bag divided by the decontamination factor from the two HEPA filters mounted in series in the STU exhaust train.

Emission rate of i (upstream of HEPAs) = Emission rate of i from the GM/CB

Emission rate of i (downstream of HEPAs) = Emission rate of i (upstream of HEPAs) / DF

Each HEPA filter has an efficiency of 99.95%, which is a DF of 2000:

- For organics and ammonia, DF = 1.0
- For inorganics, DF = 2000 * 2000 = 4E+06

The concentration in the stack exhaust (upstream of the HEPA filters) is the emission rate divided by the airflow:

Conc of i in STU Exhast = Emission rate of i (downstream of HEPAs) / Air flow

The off-gas concentrations are given in Table A-2. The hourly emission rate from the STU exhaust stack is the hourly emission rate from the Grout Mixer/containment bag divided by the DF. The annual emission rate uses the hourly emission rate from the STU exhaust, and assumes eight hours of operation a day, 365 days a year. Hourly and annual emission rates are given in Table A-3.

Emissions during Dry Material Handling

Emissions from dry material handling are calculated based on Emission Factors (EFs) from EPA. These calculations are given in Part 3 below.

PART 1 –PARTITION IN THE ETF EVAPORATOR

Wastewaters from the ETF main treatment train pass through the ETF evaporator before entering the STU. The ETF evaporator is a single-effect evaporator without a rectifying column. This allows it to be modeled, with the vapor in equilibrium with the brine, using Henry's Law:

$$y_A P = x_A H_A \quad \text{or} \quad y_A = x_A\left(\frac{H_A}{P}\right) \quad \text{or} \quad x_A = y_A\left(\frac{P}{H_A}\right) \qquad (1)$$

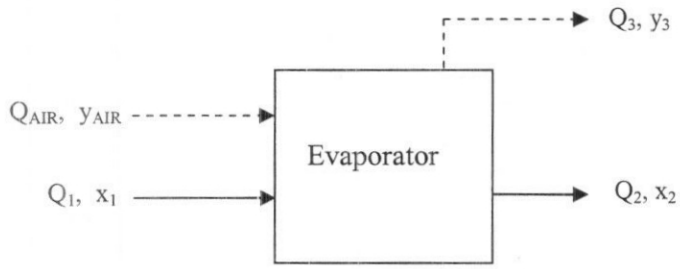
where:
y_A = mole fraction of component A in the vapor phase
x_A = mole fraction of component A in the liquid phase
H_A = Henry's Law constant for component A, atm.
P = System pressure

Values for Henry's law constants were obtained from a variety of sources. Henry's law constants are highly temperature dependent. The relationship between the Henry's law constant and the temperature dependency factor, dHsoln/K, is:

$$kH(T, oK) = kH(T,298\ oK)\exp\left(-dHsoln/K\left(\frac{1}{T, oK} - \frac{1}{298\ oK}\right)\right) \qquad (2)$$

The units for kH are mol/L-atm. To perform the calculations below, the kH is converted to units of atmosphere. The conversion is the molar density of water (55.56 mol/L) divided by kH: H (in atm) = 55.56 mol/L / (kH, mol/L-atm)

The Evaporator material balance is:



where:
Q = Molar flowrate
y = Mole fraction of constituent in air
x = Mole fraction of constituent waste solution

Since the molar flowrate of waste constituents in the air inleakage is zero ($y_{AIR} = 0$), the material balance equation of a constituent present at concentration x_1 in the feed is:

$$x_1 Q_1 = x_2 Q_2 + y_3 Q_3 \qquad (3)$$

The discharge streams are in equilibrium, so they are related by Henry's law. Substituting the Henry's Law equation, $x_2 = y_3(P/H_A)$ into Equation 3:

$$x_1 Q_1 = y_3 \left(\frac{P}{H_A} \right) Q_2 + y_3 Q_3 \qquad (4)$$

Multiplying the first portion on the right hand side by Q_3/Q_3 and rearranging:

$$x_1 Q_1 = y_3 \left(\frac{P}{H_A} \right) Q_2 \left(\frac{Q_3}{Q_3} \right) + y_3 Q_3 = y_3 \left(\frac{P}{H_A} \right) Q_3 \left(\frac{Q_2}{Q_3} \right) + y_3 Q_3$$

$$\text{or} \quad x_1 Q_1 = y_3 Q_3 \left[\left(\frac{P}{H_A} \right) \left(\frac{Q_2}{Q_3} \right) + 1 \right] \quad \text{or} \quad x_1 Q_1 = y_3 Q_3 \left[1 + \left(\frac{P}{H_A} \right) \left(\frac{Q_2}{Q_3} \right) \right] \qquad (5)$$

The percent emitted is defined as:

$$\%\ \text{of contituent evaporated} = 100 \frac{y_3 Q_3}{x_1 Q_1} \qquad (6)$$

The values for Q_1 and Q_3 are molar flowrates, but the % emitted can represents either mole percent and mass percent, since the molecular weight drops out of the equation. Rearranging Equation 5 and inserting into Equation 6:

$$\%\ \text{of constituent evaporated} = 100 \frac{y_3 Q_3}{x_1 Q_1} = 100 \left[\frac{1}{1 + \left(\frac{P}{H_A} \right) \left(\frac{Q_2}{Q_3} \right)} \right] \qquad (7)$$

% of constituent in brine = 100 - % of constituent evaporated (8)

In Equation 7, as the Henry's Law constant increases, or the boiloff rate Q_3 increases, the denominator decreases, and the % emitted increases. Because the quantities of volatile constituents is small compared to the total flow, Q_1, Q_2, and Q_3 can be readily determined by the material balance of air and water. In the ETF Evaporator, the value of Q_2 is much less than Q_3, so the % evaporated on most organic constituents is high. The percentage of each organic constituent emitted is given in Table A-1.

These equilibrium calculations are used to determine the percent boiloff of organic constituents. For the inorganic constituents, including ammonium nitrate/ammonium sulfate, the percent boiloff in the evaporator is assumed to be zero, as these compounds are present as dissolved salts.

PART 2A - AMMONIA EMISSIONS FROM THE GROUT MIXER

Ammonia emissions from the Grout Mixer and containment bag are based on testing performed at Columbia Basin College. The ammonia concentration in the vapor space was monitored during a test where ammonia-bearing waste simulant was grouted with a dry material similar to what will be used at STU. The emissions were reported as grams per cubic meter; however, these units are not useful because the air concentration depends on the ventilation flowrate. Instead, the experimenters converted the emission rate to grams per second (FFS 2006).

In order to scale up the test conditions to an actual waste block, it is assumed that the percentage of the ammonia in the waste that is emitted is not affected by the concentration of ammonia in the waste (i.e., 5% of the ammonia would be emitted whether the ammonia concentration is 1 g/L or 100 g/L). This is reasonable, since it is the basis of Henry's Law (y/x = H/P, the value of H/P is not affected by x). Other factors, most notably the pH of the waste, do affect the percent ammonia emitted, but these will be the same in the actual waste block as in the experiment. The percent emitted is:

$$\%\ \text{ammonia emitted per second} = 100 * \frac{\text{ammonia emitted, g per second}}{\text{total ammonia in the waste simulant, g}}$$

The percent emitted per second during testing is given in Figure 5 of the document. After a brief mixing period (less than 2 minutes), emissions rise sharply, then begin to drop off. After about 17 minutes, the emissions leveled out, although in theory it would continue to decrease slowly over time. Testing was discontinued after 26 minutes when the initial curing was completed.

The variability of the percent emitted per second data makes extrapolating the results to one hour difficult. However, if the data is graphed as an accumulation over time, it fits a smooth curve (see Figure 6 of the document). The data in Figure 6 of the document is the integration of the data in Figure 5. A curve was fitted to Figure 6 using a trend line formula in Excel©. The formula is: y = 0.0812 * minutes elapsed + 0.3697. The emission formula is then:

% ammonia emittted after time t = 0.0812 * t, minutes + 0.3697

The projected emissions are:

Total emitted in first hour = 0.0812 * 60 minutes + 0.3697 = 5.2%
Total emitted after two hours = 0.0812 * 120 minutes + 0.3697 = 10.1%

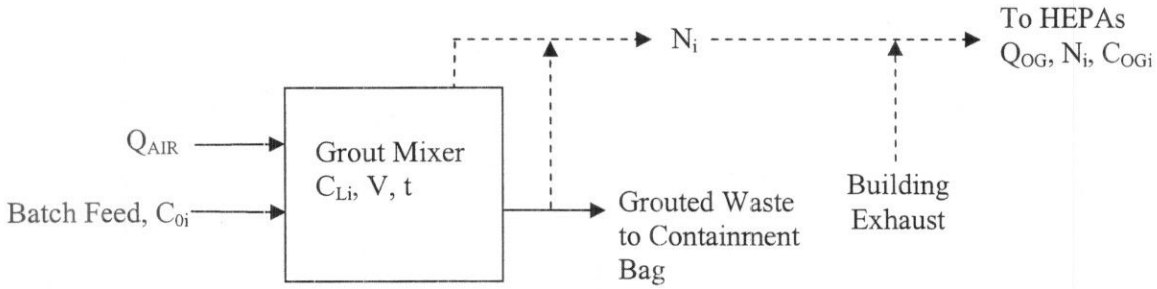
The total emitted in the second hour is 10.1 – 5.2 = 4.9%. Because of the initial spike during the first hour, emissions from subsequent hours will not exceed 5.2% per hour. For a waste containing 16 kg of ammonia, the emission will be:

Emission = (5.2% / 100) * 16 kg (2.205 lb/kg) = 1.8 lbs per hour.

Thus, if the total amount of ammonia in a single batch is 16 kilograms or less, the emission will be below the SQER.

PART 2B - ORGANIC EMISSIONS FROM THE GROUT MIXER

The emission of organic constituents from the Grout Mixer at STU is based on mass transfer equations in *Compilation of Air Emission Factors AP-42, Volume I, Chapter 4, Evaporation Loss Sources*. Section 4.3, "Waste Water Collection, Treatment and Storage," (EPA 1995) has equations for determining emissions from outdoor wastewater treatment plant with unagitated pools. The emission calculations use gas-phase and liquid-phase mass transfer coefficients. The equation for the gas-phase mass transfer coefficient given by EPA is used; however, the liquid-phase mass transfer coefficient equation is not used because it does not account for the Grout Mixer being agitated. Instead, an equation from *Chemical Engineers' Handbook*, (Perry 1997) is used.



Where:
C_{0i} = Concentration of constituent i in the feed, g/m3
Q_{AIR} = Air inleakage, m3
V = Volume of wastewater in the Grout Mixer, m3
C_{Li} = Concentration of constituent i in the Grout Mixer, g/m3
t = time wastewater is in the Grout Mixer, s
N_i = Mass emission rate of constituent i, g/s
C_{OGi} = Concentration of constituent I in the off-gas
Q_{OG} = Off-gas rate, m3/s

Note that the concentration in the mixer, C_{Li}, is not equal to the concentration in the feed, C_{0i}, because a fraction of the constituent is emitted. The off-gas concentration, C_{OGi}, is equal to the mass emission rate, N_i, divided by the off-gas flowrate, Q_{OG}.

Emission Rate

The mass transfer from a tank where the liquid and gas phases are not at equilibrium is given by (Equation 12 in EPA 1995):

$$N_i = K_i \; C_{Li} \; A \qquad (1) \qquad \text{where:} \quad C_{Li} = \frac{Q\,C_{Oi}}{K_i A + Q} \qquad (2)$$

where:
K_i is the overall mass transfer coefficient of constituent i from liquid phase to gas phase, m/s
A is the surface area of contact between the liquid and gas phases, m^2
Q is the volumetric flowrate of liquid phase, m3/s

The value for the overall mass transfer coefficient is based on the mass transfer coefficients in the liquid and gas phases, and the equilibrium across the interface (Equation 7 in EPA 1995):

$$\frac{1}{K_i} = \frac{1}{k_{li}} + \frac{1}{k_{gi}\,Keq_i} \quad \text{or} \quad K = \frac{k_{li} Keq_i k_{gi}}{Keq_i k_{gi} + k_{li}} \qquad (3) \qquad \text{where:} \quad Keq_i = \frac{H_i}{R\,T} \qquad (4)$$

where:

k_{li} is the mass transfer coefficient of constituent i in the liquid phase, m/s
k_{gi} is the mass transfer coefficient of constituent i in the gas phase, m/s
Keq_i is the equilibrium constant of constituent i, dimensionless
H_i is the Henry's law constant for constituent i at the system temperature, atm-m^3/mol
R is the ideal gas constant, 8.206E-05 atm-m^3/mol-K
T is the system temperature, °K

Values for Henry's law constants were obtained from a variety of sources. Henry's law constants are highly temperature dependent. The temperature dependency factor is discussed in Part 1.

Percent Emitted

Since the Grout Mixer is operated in batches, the percent emitted is determined based on the volume of Grout Mixer. The volume of wastewater in a batch in the Grout Mixer is assumed to be a maximum of 181 gallons.

$$\% \text{ emitted of constituent i} = 100\frac{N_i t}{C_{0i} V} \qquad (5)$$

Where $N_i t$ is the mass of constituent i emitted and $C_{0i}V$ is the mass of constituent i in the Grout Mixer. Note that the value of V/t is equal to Q, where Q is the volumetric flowrate of the liquid phase. Equation 5 can be rewritten as:

$$\% \text{ emitted} = 100\frac{N_i t}{C_{0i} V} = 100\frac{N_i}{C_{0i}}\left(\frac{t}{V}\right) = 100\frac{N_i}{C_{0i} Q} \qquad (6)$$

Substituting Equations 1 and 2 into Equation 6 yields:

$$\% \text{ emitted} = 100\frac{K_i C_{Li} A}{C_{0i} Q} = 100\frac{K_i A}{C_{0i} Q} C_{Li} = 100\frac{K_i A}{C_{0i} Q}\left(\frac{QC_{0i}}{K_i A + Q}\right) \qquad (7)$$

The value of $C_{0i}Q$ can be factored out of Equation 7 and the equation can be simplified:

$$\% \text{ emitted} = 100\frac{K_i A}{K_i A + Q} = 100\left[\frac{1}{1 + Q/K_i A}\right] \qquad (8)$$

Notice that as the mass transfer rate increases, Q/KA decreases, and the percent emitted increases. Notice also that as the flow increases, the percent emitted decreases. This may not seem correct, but remember the actual quantity emitted (i.e., flow * percent emitted) increases as Q increases.

Gas Phase Mass Transfer Coefficient

The gas phase mass transfer coefficient is based on the air velocity over the surface of the solution (Equation 2 of EPA 1995):

$$k_{gi} = (4.82\text{E-}03)\,(U_{10})^{0.78}\,(Sc_{Gi})^{-0.67}\,(d_e)^{-0.11} \qquad (9)$$

where: $Sc_{Gi} = \frac{\mu_a}{\rho_a D_{ai}}$ (6) and $d_e = 2(A/\pi)^{0.5}$ (10)

where:

U_{10} is the velocity of the airflow 10 meters above the surface of the solution, m/s
Sc_{Gi} is the Schmidt number of constituent i in the gas phase, dimensionless
d_e is the effective diameter of the surface of the solution, m
μ_a is the viscosity of air at the system temperature, g/cm-s
ρ_a is the density of air at the system temperature, g/cm^3
D_{ai} is the diffusion of constituent i in air, cm^2/s
A is the surface area of the vessel, m2

The air velocity in the vapor space of the Grout Mixer will be used for U_{10}. A velocity of 7.07E-02 m/s was calculated based on the air flowrate of 50 ft3/min divided by the cross-sectional area in the Grout Mixer vapor space. The cross-sectional area is based on dimensions from preliminary design drawings of the Grout Mixer.

The diffusivities of constituents in air at 25°C (298°K) were obtained from various sources. Equations for determining diffusivity given on the EPA website, *EPA On-line Tools for Site Assessment*, "Diffusion Coefficient Estimation – Extended Input Range," (EPA 2006a) give a temperature dependence of $T^{1.75}$. The diffusivity was therefore adjusted for system temperature using the factor $(T/298)^{1.75}$.

When calculated, the values for the gas phase mass transfer coefficients range from 1.1E-04m/s to 4.7E-04 m/s, except for acetone, which has a value of 8.1E-04 m/s due to its high diffusivity. For simplicity, the maximum value of **4.7E-04 m/s** will be applied to all constituents except acetone.

Liquid Phase Mass Transfer Coefficient

The liquid phase mass transfer coefficient equation supplied by EPA (EPA 1995) will not be used because it applies to non-agitated tanks. Instead, an equation from the *Chemical Engineer's Handbook* is used, based on the agitator power, tank volume, and gas velocity (Equation 14-219 in Perry 1997):

$$k_l * a = 0.002 * \left(\frac{PWR}{V}\right)^{0.7} * U_s^{0.2}, \text{ where } a = A/V \text{ (for ionic mixtures)} \qquad (8)$$

$$k_l = (k_l * a) / (A/V) \qquad (9)$$

where:
a is the interfacial specific area = A/V, m^{-1} — V is the volume of the tank, m3
A is the surface area of the vessel, m2 — U_s is the superficial gas velocity in the liquid phase, m/s
PWR is the power of the agitator, W

The superficial gas velocity, U_s, is the velocity of gas in the liquid phase. In an agitated tank, the maximum velocity in the gas phase would be the impeller discharge rate divided by the impeller area.

$$U_s = Q_I / A_I, \quad \text{where } A_I = 0.25 * \pi * D_I^2 \qquad (10)$$

where:
Q_I is the impeller discharge rate, m^3/s — D_I is the impeller diameter, m
A_I is the impeller area, m2

The impeller diameter can be obtained from vendor information, while the impeller discharge rate is given by Perry (Equation 18-2 in Perry 1997):

$$Q_I = N_Q * N * D_I^3 \qquad (11)$$

where:
N_Q is the impeller discharge coefficient, dimensionless
N is the rotational speed, rev/s
D_I is the impeller diameter, ft

Perry's gives a value for N_Q of 0.5 for single impellers and a maximum value of 2.9 for turbines. Since agitation in the Grout Mixer will be great, the value of 2.9 is used. Agitator design parameters for the Grout Mixer, based on information from several vendors (Marion Mixer, Ross, etc) are:

- Impeller diameter (D_I) = 36 inches = 0.914 m
- Horsepower = 10 hP = 7457 W
- Rotational speed = 40 rpm = 0.667 rev/s

Impeller area A_I = 0.25 * π * (0.914^2) = 0.656 m2
Impeller discharge rate (Equation 11), Q_I = 2.9 * 0.667 * (0.914^3) = 1.48 m3/s

The superficial gas velocity, U_s, is the discharge rate divided by the area:
U_s = 1.48 m3/s / 0.656 m2 = 2.25 m/s

The volume of the liquid in the Grout Mixer is the same as a grout block, which is 3 ft by 3 ft by 3 ft = 27 ft3 (0.764 m3). k_l * a can now be calculated:

$k_l * a = 0.002 * (7457 / 0.764)^{0.7} * 2.25^{0.2} = 1.46\ s^{-1}$

Per Equation 9, a = A/V, so k_L = 1.46 / (A/V). The surface area solution in the Grout Mixer is 3 ft by 4 ft = 12 ft2 (1.114 m2)

$k_L = 1.46\ s^{-1}$ / (1.114 m2 / 0.764 m3) = **1.00 m/s**

Note that the liquid phase mass transfer coefficient is based entirely on the tank and agitator design and is independent of the constituents.

Overall Emission Rate
Given the values of k_{gi} = 4.0E-04 m/s and k_L = 0.100 m/s, the overall mass transfer coefficient, K_i, can be written in terms of H_i, R, and T:

$$\frac{1}{K_i} = \frac{1}{k_{li}} + \frac{1}{k_{gi} * Keq_i} = \frac{1}{1.00} + \frac{1}{4.0E-04 * Keq_i} \quad \text{where } Keq_i = \frac{H_i}{R * T}$$

The Henry's Law constants were obtained from a variety of sources. The value for R is 8.206E-05 m3-atm/mol-oK. T is the temperature of the Grout Mixer, in oK, which is 327oK (54oC). The value of Ki can then be used to determine the percent emitted:

$$\%\ \text{emitted from the Grout Mixer} = 100\left[\frac{1}{1 + Q/K_i A}\right]$$

The % emitted from the Grout Mixer for organic compounds are given in Table A-1.

PART 2C - INORGANIC EMISSIONS FROM THE GROUT MIXER

Due to their low vapor pressure, the emission of inorganic salts by evaporation are negligible. The source of inorganic emissions is mists generated by solution falling into vessels, agitation, etc. The emission is based on a mist concentration in the vapor space. Unlike the organic emissions, mists are removed by the HEPA filter on the STU Off-gas.

Inorganic Concentration in the Vapor Space

The previous NOC (DOE 1993) gives a mist concentration of 10 mg/m3 air. Using this value, the concentration of constituent i in the vapor space

$$C_{OG}(\text{mist})_i = 10\ \text{mg/m3 (mist)} * 0.001\ \text{g/mg} * (x_i) = 10\ \text{mg/m3 (mist)} * 0.001\ \text{g/mg} * \left(\frac{C_{Li}}{\rho_L}\right) \quad (1)$$

where:
$C_{OG}(\text{mist})_i$ is the concentration of constituent i in the off-gas due to mist generation, g/m3
x_i is the mass fraction of constituent i, g constituent/g waste = C_{Li} / ρ_L
C_{Li} is the concentration of constituent i in the liquid, g/m3
ρ_L is the density of the liquid phase, g/m3

The density of the liquid phase ranges from 1680 kg/m3 to 1760 kg/m3, from *Conceptual Design Report for Effluent Treatment Facility Solidification Treatment Unit* (HNF 2006). A value of 1680 kg/m3 (1.68E+06 g/m3) is used because it yields the greatest percent emitted.

The emission rate is the off-gas concentration multiplied by the flowrate:

$$\text{Emission rate, g/min} = C_{OG}(\text{mist})_i\text{, g/m3} * \text{Q, ft3/min} * \left(\frac{T}{T_{STD}}\right) \quad (2)$$

Given a Grout Mixer air flowrate of 50 ft3/min at standard conditions, and the temperature in the Grout Mixer is 130oF (54oC), the emission rate can be expressed as:

$$\text{Emission rate, g/min} = C_{OG}(\text{mist})_i\text{, g/m3} * 50\ \text{ft3/min} * 0.028317\ \text{m3/ft3} * \left(\frac{54 + 273\ \text{oK}}{273\ \text{oK}}\right) \quad (3)$$

Substituting Equation 1 into Equation 3:

$$\text{Emission rate, g/min} = 10\ \text{mg/m3 (mist)} * 0.001\ \text{g/mg} * \left(\frac{C_{Li}}{1.68\text{E}+06\ \text{g/m3}}\right) * 50\ \text{ft3/min}$$

$$* 0.028317\ \text{m3/ft3} * \left(\frac{54 + 273\ \text{oK}}{273\ \text{oK}}\right) = C_{Li} * 1.01\text{E}-08\ \text{g/min}$$

The Grout Mixer has a maximum volume of 181 gallons of wastewater, and the waste stays in the Grout Mixer/containment bag for one hour, so the feed rate of a constituent of concentration C_{0i} is:

$$\text{Feed rate, g/min} = C_{0i}\text{, g/m3} * \frac{181\ \text{gal} * 0.003785\ \text{m3/gal}}{60\ \text{min}} = C_{0i} * 0.0114\ \text{g/min} \quad (4)$$

Where C_{0i} is the concentration in the brine entering the Grout Mixer. The % emitted is:

$$\%\ \text{emitted} = 100 * \frac{\text{Emission rate, g/min}}{\text{Feed rate, g/min}} = 100 * \frac{C_{Li} * 1.01\text{E}-08\ \text{g/min}}{C_{0i} * 0.0114\ \text{g/min}}$$

Because the emission rate of inorganics is very low, the concentration entering the Grout Mixer will be equal to concentration in the Grout Mixer ($C_{0i} = C_{Li}$).

$$\%\ \text{emitted from Grout Mixer} = 100 * \frac{1.01\text{E}-08\ \text{g/min}}{0.0114\ \text{g/min}} = 8.9\text{E}-05\ \%$$

This % emitted applies to all inorganic constituents. Note that each of the two HEPA filters remove greater than 99.95% (DF = 2000) of the mists before the airflow enters the STU Exhaust Stack.

PART 3 – EMISSION FROM DRY MATERIAL HANDLING

Five dry materials were considered for use in the solidification process. The makeup of these materials vary. The values used in calculating the emissions in Tables 4 and 5 are taken from the *Conceptual Design Report for Effluent Treatment Facility Solidification Treatment Unit* (HNF 2006). The blend of the five materials may vary, the current blend being:

Portland Cement	36.1%
Flyash	0.0%
Blast Furnace Slag	36.1%
Secar 51©	0.0%
Hydrated Lime	27.8%

The total quantity of dry material used per year, based on 1500 lbs per block, eight blocks per day, is:

Annual dry material usage = 1500 lbs/block * 8 block/day * 365 days/year / 2000 lbs/ton
= 2200 tons/year

Dry material emissions occur during dry material transfers, when air and dry material are in movement. Four transfers occur: 1) pneumatic transfers from pressurized supply tankers to the storage silos; 2) gravity transfers from the storage silos to the weigh hoppers; 3) pneumatic transfers (by vacuum) from the weigh hoppers to the feed hopper; and 4) gravity transfers from the feed hopper to the Grout Mixer.

Emission Factors

EPA provides emissions factors (EFs) for concrete batching in *Compilation of Air Emission Factors AP-42*, Volume I, Chapter 11, "Mineral Products Industry". Section 11.12 (EPA 2006b) provides EFs as follows:

	Uncontrolled		Controlled	
Source	Total PM	Total PM_{10}	Total PM	Total PM_{10}
Cement unloading to elevated storage silos (pneumatic)	0.72	0.46	0.00099	0.00034
Cement supplement unloading to elevated storage silos (pneumatic)	3.14	1.10	0.0089	0.0049
Weigh hopper loading	0.0051	0.0024	ND	ND

Units: pounds emitted per ton of material transferred.

ND = Not detected
PM = particulate matter
PM_{10} = particulate matter with particle size below 10 micron

EPA defines a cement supplement as "mineral admixtures or pozzalan materials" added to improve the quality or reduce the cost of the mixture. EPA specifically lists flyash and blast furnace slag as cement supplements. Although not listed by EPA, hydrated lime will be treated as a cement supplement.

Uncontrolled emissions are open-air emissions where no controls are implemented. Controls include: water sprays, enclosures, hoods, curtains, shrouds, movable and telescoping chutes, central dust collection systems, etc. The STU storage silos use enclosures with filtration.

The emission can be determined by taking the total transfer of the dry material multiplied by the emission factor:

Emission, lbs = emission factor, lbs per ton * tons transferred (1)

The emission of individual constituents, such as calcium oxide, is determined by multiplying this emission by the percent of the constituent present in the dry material.

Pneumatic Transfers from the Supply Trucks to the Storage Silos

Dry material is transferred from a supply truck to a storage silo by pressurizing the truck tank with compressed air and blowing the material through piping into the silo. The pressurized air exhausts from the storage silo through filtration units. Since only one truck will be unloading at a time, the maximum hourly rate is the maximum emission from a single silo. Based on information from vendors, the maximum size of the cement trucks is 38 tons, while the maximum size of other trucks is 25 tons. Emission rates are determined using Equation 1. Hourly and annual emissions from these transfers are given in Table A-4.

Gravity Transfers from Storage Silos to the Weigh Hoppers

The dry material is transferred from the storage silos to the smaller weigh hoppers by gravity through a metering valve. Per the EF values above, the emission is considered non-detectable.

Pneumatic Transfers from the Weigh Hoppers to the Feed Hopper

This vacuum transfer is similar to a pneumatic transfer because the dry material is transferred by moving air. In fact, the annual emissions from transferring from the weigh hoppers to the feed hopper is the same as transferring from the supply trucks to the storage silos, since the same amount of material is transferred to both, and the EFs are the same.

Hourly emissions are based on the volume of the weigh hopper and bulk density of the dry material:

Emission, lbs = emission factor, lbs per ton * volume of weigh hopper, ft3 * bulk density of the dry material, lb/ft3 / 2000 lbs/ton. (2)

Since the volume of each weigh hoppers is small (7.5 ft3), it is possible that all three hoppers could be filled and transferred to the feed hopper in one hour. Therefore the emission from the three transfers are added together to determine the hourly rate. Hourly and annual emissions from these transfers are given in Table A-5.

Gravity transfers Storage Silos to the Weigh Hoppers

The dry material is transferred from the feed hopper to the Grout Mixer by gravity through a metering valve. Per the EF values above, the emission is considered non-detectable.

Total emissions:

The total annual emission is the sum of the annual emissions from the two pneumatic transfers: from the supply trucks to the storage silos and from the weigh hoppers to the feed hopper.

The hourly emission is the maximum of the hourly emission from the transfer from the supply truck to the storage silos, or the hourly emission from the transfer from the weigh hoppers to the feed hopper. Calculations show that the former transfer is the larger. The maximum hourly and total annual emission rates are given in Table 4 in the body of the document.

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Table A-1 – STU Inlet Composition and Percent Emitted.

Constituent	CAS No.	TAP	Influent	Evaporator			STU		
			Influent Conc[1] mg/L (ppm)	% of Influent Evaporated (returned to ETF) % by mass	% of Influent in Brine (to STU) % by mass	Brine Conc (to STU)[2] mg/L	Total in Grout Mixer[3] mg	% in Grout Mixer Evaporated (to HEPAs) % by mass	% of Influent Evaporated (to HEPAs) % by mass
1,1,1-Trichloroethane (Methyl chloroform)	71-55-6	B	0.00073	100.000	2.9E-04	5.7E-08	3.9E-05	82.612	2.4E-04
1,1,2-Trichloroethane	79-00-5	B	0.00031	99.998	2.2E-03	1.9E-07	1.3E-04	26.875	5.9E-04
1,2-Dichloroethane	107-06-2	B	0.00011	99.997	2.8E-03	8.6E-08	5.9E-05	28.086	8.0E-04
1,4-Dichlorobenzene	106-46-7	AI,AII	0.0001	99.996	3.6E-03	9.9E-08	6.8E-05	35.300	1.3E-03
1-Butanol (n-Butyl alcohol)	71-36-3	B	11	99.953	4.7E-02	1.4E-01	9.7E+01	0.668	3.1E-04
2-Butanone (Methyl ethyl ketone)	78-93-3	B	0.053	99.976	2.4E-02	3.5E-04	2.4E-01	2.623	6.4E-04
2-Butoxyethanol	111-76-2	B	0.4	99.759	2.4E-01	2.7E-02	1.8E+01	0.136	3.3E-04
4,4'-DDE	3547-04-4	AI,AII	0.00032	99.939	6.1E-02	5.4E-06	3.7E-03	0.533	3.3E-04
4,4'-DDT	50-29-3	AI,AII	0.0042	99.936	6.4E-02	7.3E-05	5.0E-02	1.103	7.0E-04
Acetone	67-64-1	B	1.0	99.946	5.4E-02	1.5E-02	1.0E+01	2.471	1.3E-03
Aldrin	309-00-2	AI,AII	0.0018	99.947	5.3E-02	2.6E-05	1.8E-02	1.322	7.0E-04
Benzene	71-43-2	AI,AII	0.002	99.999	6.8E-04	3.8E-07	2.6E-04	62.779	4.3E-04
Carbon tetrachloride	56-23-5	AI,AII	0.44	100.000	1.1E-04	1.4E-05	9.5E-03	90.602	1.0E-04
Chloroform	67-66-3	AI,AII	0.014	99.999	6.3E-04	2.4E-06	1.7E-03	59.022	3.7E-04
Dieldrin	60-57-1	AI,AII	0.0038	99.867	1.3E-01	1.4E-04	9.5E-02	0.530	7.0E-04
Dodecane	112-40-3	No	100	100.000	4.8E-07	1.3E-05	9.0E-03	99.941	4.8E-07
Endrin	72-20-8	B	0.0044	99.949	5.1E-02	6.2E-05	4.3E-02	0.634	3.3E-04
Endrin aldehyde	7421-93-4	No	0.00067	99.949	5.1E-02	9.5E-06	6.5E-03	0.634	3.3E-04
Ethyl benzene	100-41-4	B	0.0009	99.999	6.8E-04	1.7E-07	1.2E-04	66.626	4.5E-04
gamma-BHC (Lindane) (Hexachlorocyclohexane)	58-89-9	AI,AIII	0.0017	99.916	8.4E-02	3.9E-05	2.7E-02	0.738	6.2E-04
Heptachlor	76-44-8	AI,AII	0.0017	99.997	3.1E-03	1.5E-06	1.0E-03	26.888	8.4E-04
m-Cresol (Cresol, all isomers)	108-39-4 (1319-77-3)	B	0.074	99.841	1.6E-01	3.2E-03	2.2E+00	0.161	2.6E-04
Methyl isobutyl ketone	108-10-1	B	0.014	99.984	1.6E-02	6.3E-05	4.3E-02	5.273	8.6E-04
Methyl n-butyl ketone (2-Hexanone)	591-78-6	B	0.014	99.972	2.8E-02	1.1E-04	7.4E-02	3.143	8.8E-04

Table A-1 – STU Inlet Composition and Percent Emitted.

Constituent	CAS No.	TAP	Influent	Evaporator			STU		
			Influent Conc[1] mg/L (ppm)	% of Influent Evaporated (returned to ETF) % by mass	% of Influent in Brine (to STU) % by mass	Brine Conc (to STU)[2] mg/L	Total in Grout Mixer[3] mg	% in Grout Mixer Evaporated (to HEPAs) % by mass	% of Influent Evaporated (to HEPAs) % by mass
Methyl n-propyl ketone (2-Pentanone)	107-87-9	B	0.0097	99.979	2.1E-02	5.5E-05	3.8E-02	4.200	8.7E-04
Methylene chloride (Dichloromethane)	75-09-2	AI,AII	0.14	100.000	5.0E-04	1.9E-05	1.3E-02	73.132	3.6E-04
Pentachlorophenol	87-86-5	AI,AII	0.027	98.477	1.5E+00	1.1E-02	7.7E+00	0.021	3.2E-04
Phenol	108-95-2	B	0.84	98.634	1.4E+00	3.2E-01	2.2E+02	0.027	3.7E-04
Tetrachloroethene (Perchloroethylene)	127-18-4	AI,AII	0.00062	100.000	1.3E-04	2.1E-08	1.5E-05	87.371	1.1E-04
Tetradecane	629-59-4	No	0.18	100.000	3.0E-06	1.5E-07	1.0E-04	99.723	3.0E-06
Tetrahydrofuran	109-99-9	B	0.039	99.986	1.4E-02	1.6E-04	1.1E-01	3.844	5.6E-04
Toluene	108-88-3	B	0.0006	100.000	4.3E-04	7.1E-08	4.9E-05	68.499	3.0E-04
Tributyl phosphate	126-73-8	No	30	97.487	2.5E+00	2.1E+01	1.4E+04	0.013	3.2E-04
Trichloroethene	79-01-6	AI,AII	0.008	100.000	2.8E-04	6.2E-07	4.3E-04	77.544	2.2E-04
Xylenes (total)	1330-20-7	B	0.0016	99.999	5.2E-04	2.3E-07	1.6E-04	65.514	3.4E-04
Ammonia[3]	7664-41-7	B	511	0	100	23,355	1.6E+07	5.242	5.24E+00
Aluminum	7429-90-5	B	1.33	0	100	109	7.5E+04	8.9E-05	8.9E-05
Antimony	7440-36-0	B	0.1	0	100	8	5.6E+03	8.9E-05	8.9E-05
Barium	7440-39-3	B	0.3	0	100	25	1.7E+04	8.9E-05	8.9E-05
Beryllium	7440-41-7	AI,AII	0.0019	0	100	0.16	1.1E+02	8.9E-05	8.9E-05
Boron	7440-42-8	B	0.097	0	100	8	5.4E+03	8.9E-05	8.9E-05
Bromide	24959-67-9	No	0.4	0	100	33	2.2E+04	8.9E-05	8.9E-05
Cadmium	7440-43-9	AI,AII	0.0072	0	100	0.6	4.0E+02	8.9E-05	8.9E-05
Calcium (from waste)	7440-70-2	B	330	0	100	26,999	1.9E+07	8.9E-05	8.9E-05
Calcium (from dry materials)[5]	7440-70-2	B				1,394	(included above)	(included above)	(included above)
Chloride	16887-00-6	No	59	0	100	4,827	3.3E+06	8.9E-05	8.9E-05
Chromium	7440-47-3	AI,AII	0.18	0	100	15	1.0E+04	8.9E-05	8.9E-05
Cobalt	7440-48-4	No	0.005	0	100	0.41	2.8E+02	8.9E-05	8.9E-05
Copper	7440-50-8	B	0.79	0	100	65	4.4E+04	8.9E-05	8.9E-05
Cyanide	57-12-5	B	0.01	0	100	0.8	5.6E+02	8.9E-05	8.9E-05

Table A-1 – STU Inlet Composition and Percent Emitted.

Constituent	CAS No.	TAP	Influent	Evaporator			STU		
			Influent Conc[1] mg/L (ppm)	% of Influent Evaporated (returned to ETF) % by mass	% of Influent in Brine (to STU) % by mass	Brine Conc (to STU)[2] mg/L	Total in Grout Mixer[3] mg	% in Grout Mixer Evaporated (to HEPAs) % by mass	% of Influent Evaporated (to HEPAs) % by mass
Fluoride	16984-48-8	B	4	0	100	327	2.2E+05	8.9E-05	8.9E-05
Hydroxide (from dry materials)[5]	OH	B				1,539	1.1E+06	8.9E-05	8.9E-05
Iron	7439-89-6	B	9.4	0	100	769	5.3E+05	8.9E-05	8.9E-05
Lead	7439-92-1	III	0.0033	0	100	0.27	1.8E+02	8.9E-05	8.9E-05
Magnesium	7439-95-4	No	110	0	100	9,000	6.2E+06	8.9E-05	8.9E-05
Manganese	7439-96-5	B	0.033	0	100	2.7	1.8E+03	8.9E-05	8.9E-05
Mercury	7439-97-6	B	0.00031	0	100	0.025	1.7E+01	8.9E-05	8.9E-05
Nickel	7440-02-0	AI,AII	0.12	0	100	10	6.7E+03	8.9E-05	8.9E-05
Nitrate	14797-55-8	B	1700	0	100	139,084	9.5E+07	8.9E-05	8.9E-05
Nitrite	14797-65-0	No	12	0	100	982	6.7E+05	8.9E-05	8.9E-05
Potassium (from waste)	7740-09-7	B	13	0	100	1,064	1.3E+06	8.9E-05	8.9E-05
Potassium (from dry materials)[5]	7740-09-7	B				784	(included above)	(included above)	(included above)
Silicon	7440-21-3	No	24	0	100	1,984	1.4E+06	8.9E-05	8.9E-05
Silver	7440-22-4	B	0.0061	0	100	0.5	3.4E+02	8.9E-05	8.9E-05
Sodium (from waste)	7440-23-5	B	59	0	100	4,827	4.7E+06	8.9E-05	8.9E-05
Sodium (from dry materials)[5]	7440-23-5	B				2,103	(included above)	(included above)	(included above)
Strontium	7440-24-6	No	1.27	0	100	104	7.1E+04	8.9E-05	8.9E-05
Sulfate (from waste)	14808-79-8	B	1398	0	100	114,344	9.6E+07	8.9E-05	8.9E-05
Sulfate (from dry materials)[5]	14808-79-8	B				25,298	(included above)	(included above)	(included above)
Uranium	7440-61-1	B	16.4	0	100	1,342	9.2E+05	8.9E-05	8.9E-05
Vanadium	7440-62-2	B	0.04	0	100	3.3	2.2E+03	8.9E-05	8.9E-05
Zinc	7440-66-6	No	0.33	0	100	27	1.8E+04	8.9E-05	8.9E-05

Table A-1 – STU Inlet Composition and Percent Emitted.

Constituent	CAS No.	TAP	Influent	Evaporator			STU		
			Influent Conc[1] mg/L (ppm)	% of Influent Evaporated (returned to ETF) % by mass	% of Influent in Brine (to STU) % by mass	Brine Conc (to STU)[2] mg/L	Total in Grout Mixer[3] mg	% in Grout Mixer Evaporated (to HEPAs) % by mass	% of Influent Evaporated (to HEPAs) % by mass

[1] - Influent concentrations are the maximum values from:
- Appendix A of *Notice for Approval of Construct the 242-A Evaporator/PUREX Plant Process Effluent Treatment Facility*, DOE/RL-92-69, Rev 0. Concentrations are for 242-A Evaporator process condensate.
- Table 2 of *Nonradioactive Air Emissions Modification to the Notice of Construction for the 200 Area Effluent Treatment Facility*, DOE/RL-96-78, Rev 0.
Influent concentrations are based on the influent being routed directly to SWRTs.

[2] - The Grout MIxer concentrations assume all the inorganic constituents remain in the evaporator brine. A specific gravity of is used 1.09 for the evaporator brine based on process results.

[3] - Total in STU Grout Mixer is based on a volume of 181 gallons of wastewater.

[4] - Ammonia emissions rate determined from CBC laboratory testing.

[5] - The cement mixture includes compounds soluble in water: sodium oxide, potassium oxide, calcium oxide (in part), and sodium sulfide/sulfate.

Table A-2 – STU Exhaust Concentrations.

Constituent	CAS No.	TAP	TAP description[1]	Compound	Compound Conversion Factor[2] unitless	STU HEPA Filter Inlet Conc. @ 6000 scfm ug/m3	DF of STU Filters[3] unitless	STU HEPA Filter Outlet Conc. ug/m3
1,1,1-Trichloroethane (Methyl chloroform)	71-55-6	B			1.0	2.9E-06	1.0	2.9E-06
1,1,2-Trichloroethane	79-00-5	B			1.0	3.1E-06	1.0	3.1E-06
1,2-Dichloroethane	107-06-2	B			1.0	1.5E-06	1.0	1.5E-06
1,4-Dichlorobenzene	106-46-7	AI,AII			1.0	2.1E-06	1.0	2.1E-06
1-Butanol (n-Butyl alcohol)	71-36-3	B			1.0	5.8E-02	1.0	5.8E-02
2-Butanone (Methyl ethyl ketone)	78-93-3	B			1.0	5.7E-04	1.0	5.7E-04
2-Butoxyethanol	111-76-2	B			1.0	2.2E-03	1.0	2.2E-03
4,4'-DDE	3547-04-4	AI,AII			1.0	1.8E-06	1.0	1.8E-06
4,4'-DDT	50-29-3	AI,AII			1.0	5.0E-05	1.0	5.0E-05
Acetone	67-64-1	B			1.0	2.3E-02	1.0	2.3E-02
Aldrin	309-00-2	AI,AII			1.0	2.1E-05	1.0	2.1E-05
Benzene	71-43-2	AI,AII			1.0	1.5E-05	1.0	1.5E-05
Carbon tetrachloride	56-23-5	AI,AII			1.0	7.7E-04	1.0	7.7E-04
Chloroform	67-66-3	AI,AII			1.0	8.8E-05	1.0	8.8E-05
Dieldrin	60-57-1	AI,AII			1.0	4.5E-05	1.0	4.5E-05
Dodecane	112-40-3	No			1.0	8.1E-04	1.0	8.1E-04
Endrin	72-20-8	B			1.0	2.4E-05	1.0	2.4E-05
Endrin aldehyde	7421-93-4	No			1.0	3.7E-06	1.0	3.7E-06
Ethyl benzene	100-41-4	B			1.0	6.9E-06	1.0	6.9E-06
gamma-BHC (Lindane) (Hexachlorocyclohexane)	58-89-9	AI,AIII			1.0	1.8E-05	1.0	1.8E-05
Heptachlor	76-44-8	AI,AII			1.0	2.4E-05	1.0	2.4E-05
m-Cresol (Cresol, all isomers)	108-39-4 (1319-77-3)	B			1.0	3.2E-04	1.0	3.2E-04
Methyl isobutyl ketone	108-10-1	B			1.0	2.0E-04	1.0	2.0E-04
Methyl n-butyl ketone (2-Hexanone)	591-78-6	B			1.0	2.1E-04	1.0	2.1E-04

Table A-2 – STU Exhaust Concentrations.

Constituent	CAS No.	TAP	TAP description[1]	Compound	Compound Conversion Factor[2] unitless	STU HEPA Filter Inlet Conc. @ 6000 scfm ug/m3	DF of STU Filters[3] unitless	STU HEPA Filter Outlet Conc. ug/m3
Methyl n-propyl ketone (2-Pentanone)	107-87-9	B			1.0	1.4E-04	1.0	1.4E-04
Methylene chloride (Dichloromethane)	75-09-2	AI,AII			1.0	8.6E-04	1.0	8.6E-04
Pentachlorophenol	87-86-5	AI,AII			1.0	1.5E-04	1.0	1.5E-04
Phenol	108-95-2	B			1.0	5.2E-03	1.0	5.2E-03
Tetrachloroethene (Perchloroethylene)	127-18-4	AI,AII			1.0	1.2E-06	1.0	1.2E-06
Tetradecane	629-59-4	No			1.0	9.1E-06	1.0	9.1E-06
Tetrahydrofuran	109-99-9	B			1.0	3.7E-04	1.0	3.7E-04
Toluene	108-88-3	B			1.0	3.0E-06	1.0	3.0E-06
Tributyl phosphate	126-73-8	No			1.0	1.6E-01	1.0	1.6E-01
Trichloroethene	79-01-6	AI,AII			1.0	3.0E-05	1.0	3.0E-05
Xylenes (total)	1330-20-7	B			1.0	9.2E-06	1.0	9.2E-06
Ammonia	7664-41-7	B	ammonia	NH3	1.0	7.5E+04	1.0	7.5E+04
Aluminum	7429-90-5	B	Al soluble salts	Al(NO3)3	7.89	4.7E-02	2000 * 2000	1.2E-08
Antimony	7440-36-0	B	compounds as Sb	Sb	1.0	4.5E-04	2000 * 2000	1.1E-10
Barium	7440-39-3	B	soluble compounds as Ba	Ba	1.0	1.3E-03	2000 * 2000	3.4E-10
Beryllium	7440-41-7	AI,AII	Be and compounds	Be(NO3)2	14.78	1.3E-04	2000 * 2000	3.1E-11
Boron	7440-42-8	B	as boron trifluoride	BF3	6.28	2.7E-03	2000 * 2000	6.8E-10
Bromide	24959-67-9	No		Br	1.0	1.8E-03	2000 * 2000	4.5E-10
Cadmium	7440-43-9	AI,AII	Cd and compounds	Cd(NO3)2	2.10	6.8E-05	2000 * 2000	1.7E-11
Calcium	7440-70-2	B	as calcium hydroxide	CaOH	1.85	2.9E+00	2000 * 2000	7.2E-07
Chloride	16887-00-6	No		Cl	1.0	2.6E-01	2000 * 2000	6.6E-08
Chromium	7440-47-3	AI,AII	hexavalent compounds	CrO2(NO3)2	5.19	4.2E-03	2000 * 2000	1.0E-09
Cobalt	7440-48-4	No	(not present as metal dust or fume)	Co	1.0	2.2E-05	2000 * 2000	5.6E-12
Copper	7440-50-8	B	dusts and mists as Cu	Cu	1.0	3.5E-03	2000 * 2000	8.9E-10
Cyanide	57-12-5	B	as CN	CN	1.0	4.5E-05	2000 * 2000	1.1E-11
Fluoride	16984-48-8	B	as F	F	1.0	1.8E-02	2000 * 2000	4.5E-09
Iron	7439-89-6	B	soluble salts as Fe	Fe	1.0	4.2E-02	2000 * 2000	1.1E-08

Table A-2 – STU Exhaust Concentrations.

Constituent	CAS No.	TAP	TAP description[1]	Compound	Compound Conversion Factor[2] unitless	STU HEPA Filter Inlet Conc. @ 6000 scfm ug/m3	DF of STU Filters[3] unitless	STU HEPA Filter Outlet Conc. ug/m3
Lead	7439-92-1	III	compounds	Pb(NO3)2	1.60	2.4E-05	2000 * 2000	5.9E-12
Magnesium	7439-95-4	No	(not present as a fume)	Mg	1.0	4.9E-01	2000 * 2000	1.2E-07
Manganese	7439-96-5	B	compounds	Mn(NO3)2	3.26	4.8E-04	2000 * 2000	1.2E-10
Mercury	7439-97-6	B	inorganic compounds	Hg(NO3)2	1.62	2.2E-06	2000 * 2000	5.6E-13
Nickel	7440-02-0	AI,AII	Ni and compounds	Ni(NO3)2	3.11	1.7E-03	2000 * 2000	4.2E-10
Nitrate	14797-55-8	B	nitric acid	HNO3	1.02	7.7E+00	2000 * 2000	1.9E-06
Nitrite	14797-65-0	No		NO2	1.0	5.4E-02	2000 * 2000	1.3E-08
Potassium	7740-09-7	B	as potassium hydroxide	KOH	1.43	1.5E-01	2000 * 2000	3.6E-08
Silicon	7440-21-3	No	(not present as silicon tetrahydride)	Si	1.0	1.1E-01	2000 * 2000	2.7E-08
Silver	7440-22-4	B	soluble compounds as Ag	Ag	1.0	2.7E-05	2000 * 2000	6.8E-12
Sodium	7440-23-5	B	as sodium hydroxide	NaOH	1.74	6.6E-01	2000 * 2000	1.7E-07
Strontium	7440-24-6	No		Sr	1.0	5.7E-03	2000 * 2000	1.4E-09
Sulfate	14808-79-8	B	sulfuric acid	H2SO4	1.02	7.8E+00	2000 * 2000	2.0E-06
Uranium	7440-61-1	B	soluble and insoluble	U	1.0	7.4E-02	2000 * 2000	1.8E-08
Vanadium	7440-62-2	B	as V2O5	V2O5	1.79	3.2E-04	2000 * 2000	8.0E-11
Zinc	7440-66-6	No	(not present as a fume)	Zn	1.0	1.5E-03	2000 * 2000	3.7E-10

[1] - Certain constituents are TAPs as specific compounds or in specific forms (dusts, mists, etc). The descriptions are from WAC 173-460-150 and -160. Most constituents that are TAPs as compounds are converted into nitrate or hydroxide compounds.
[2] - The conversion factor changes the constituent concentration to the TAP compound concentration. For a example, sodium is converted to sodium hydroxide by multiplying by a factor of 1.74
[3] - The DF for organic constituents and ammonia is 1.0. The DF for inorganic components, present as dust or mists, is based on an efficiency of 99.95% (DF = 2000) for each filter.

Table A-3 – STU Emission Rates.

Constituent	CAS No.	TAP	TAP description	% of Influent Emitted % by mass	Stack Conc. ug/m3	ASIL ug/m3	Emission Hourly Rate[1] lb/hr	SQER lb/hr	Emission Rate[2] lb/yr	SQER lb/yr
1,1,1-Trichloroethane (Methyl chloroform)	71-55-6	B		2.4E-04	2.9E-06	6400	7.1E-11	5.0	2.1E-07	43,748
1,1,2-Trichloroethane	79-00-5	B		5.9E-04	3.1E-06	180	7.5E-11	2.6	2.2E-07	22,750
1,2-Dichloroethane	107-06-2	B		8.0E-04	1.5E-06	2700	3.6E-11	5.0	1.1E-07	43,748
1,4-Dichlorobenzene	106-46-7	AI,AII		1.3E-03	2.1E-06	1.5	5.2E-11	None	1.5E-07	500
1-Butanol (n-Butyl alcohol)	71-36-3	B		3.1E-04	5.8E-02	500	1.4E-06	5.0	4.2E-03	43,748
2-Butanone (Methyl ethyl ketone)	78-93-3	B		6.4E-04	5.7E-04	1000	1.4E-08	5.0	4.1E-05	43,748
2-Butoxyethanol	111-76-2	B		3.3E-04	2.2E-03	400	5.4E-08	5.0	1.6E-04	43,748
4,4'-DDE	3547-04-4	AI,AII		3.3E-04	1.8E-06	0.10	4.3E-11	None	1.3E-07	20
4,4'-DDT	50-29-3	AI,AII		7.0E-04	5.0E-05	0.01	1.2E-09	None	3.6E-06	10
Acetone	67-64-1	B		1.3E-03	2.3E-02	5900	5.6E-07	5.0	1.6E-03	43,748
Aldrin	309-00-2	AI,AII		7.0E-04	2.1E-05	0.0002	5.2E-10	None	1.5E-06	--
Benzene	71-43-2	AI,AII		4.3E-04	1.5E-05	0.12	3.6E-10	None	1.0E-06	20
Carbon tetrachloride	56-23-5	AI,AII		1.0E-04	7.7E-04	0.067	1.9E-08	None	5.5E-05	10
Chloroform	67-66-3	AI,AII		3.7E-04	8.8E-05	0.043	2.2E-09	None	6.3E-06	10
Dieldrin	60-57-1	AI,AII		7.0E-04	4.5E-05	0.00022	1.1E-09	None	3.2E-06	None
Dodecane	112-40-3	No		4.8E-07	8.1E-04	NA	2.0E-08	NA	5.8E-05	NA
Endrin	72-20-8	B		3.3E-04	2.4E-05	0.33	6.0E-10	0.02	1.7E-06	175
Endrin aldehyde	7421-93-4	No		3.3E-04	3.7E-06	NA	9.1E-11	NA	2.6E-07	NA
Ethyl benzene	100-41-4	B		4.5E-04	6.9E-06	1000	1.7E-10	5.0	4.9E-07	43,748
gamma-BHC (Lindane) (Hexachlorocyclohexane)	58-89-9	AI,AIII		6.2E-04	1.8E-05	1.7	4.4E-10	None	1.3E-06	500
Heptachlor	76-44-8	AI,AII		8.4E-04	2.4E-05	0.00077	6.0E-10	None	1.7E-06	None
m-Cresol (Cresol, all isomers)	108-39-4 (1319-77-3)	B		2.6E-04	3.2E-04	73	7.9E-09	1.20	2.3E-05	10,500
Methyl isobutyl ketone	108-10-1	B		8.6E-04	2.0E-04	680	5.0E-09	5.0	1.5E-05	43,748
Methyl n-butyl ketone (2-Hexanone)	591-78-6	B		8.8E-04	2.1E-04	67	5.1E-09	1.20	1.5E-05	10,500

Table A-3 – STU Emission Rates.

Constituent	CAS No.	TAP	TAP description	% of Influent Emitted % by mass	Stack Conc. ug/m3	ASIL ug/m3	Emission Hourly Rate[1] lb/hr	SQER lb/hr	Emission Rate[2] lb/yr	SQER lb/yr
Methyl n-propyl ketone (2-Pentanone)	107-87-9	B		8.7E-04	1.4E-04	2300	3.5E-09	5.0	1.0E-05	43,748
Methylene chloride (Dichloromethane)	75-09-2	AI,AII		3.6E-04	8.6E-04	0.56	2.1E-08	None	6.2E-05	50
Pentachlorophenol	87-86-5	AI,AII		3.2E-04	1.5E-04	0.33	3.6E-09	None	1.1E-05	50
Phenol	108-95-2	B		3.7E-04	5.2E-03	63	1.3E-07	1.20	3.7E-04	10,500
Tetrachloroethene (Perchloroethylene)	127-18-4	AI,AII		1.1E-04	1.2E-06	1.1	2.8E-11	None	8.2E-08	500
Tetradecane	629-59-4	No		3.0E-06	9.1E-06	NA	2.2E-10	NA	6.5E-07	NA
Tetrahydrofuran	109-99-9	B		5.6E-04	3.7E-04	2000	9.0E-09	5.0	2.6E-05	43,748
Toluene	108-88-3	B		3.0E-04	3.0E-06	400	7.4E-11	5.0	2.2E-07	43,748
Tributyl phosphate	126-73-8	No		3.2E-04	1.6E-01	NA	4.0E-06	NA	1.2E-02	NA
Trichloroethene	79-01-6	AI,AII		2.2E-04	3.0E-05	0.59	7.3E-10	None	2.1E-06	50
Xylenes (total)	1330-20-7	B		3.4E-04	9.2E-06	1500	2.2E-10	5.0	6.6E-07	43,748
Ammonium	7664-41-7	B	as ammonia	5.2E+00	7.5E+04	100	1.8	2.0	5,400	17,500
Aluminum (from waste)	7429-90-5	B	Al soluble salts as aluminum nitrate	2.2E-11	1.2E-08	6.7	1.2E-06	0.02	3.4E-03	175
Antimony	7440-36-0	B	compounds as Sb	2.2E-11	1.1E-10	1.7	1.1E-08	0.02	3.2E-05	175
Barium	7440-39-3	B	soluble compounds as Ba	2.2E-11	3.4E-10	1.7	3.3E-08	0.02	9.6E-05	175
Beryllium	7440-41-7	AI,AII	Be and compounds	2.2E-11	3.1E-11	0.00042	3.1E-09	None	9.0E-06	None
Boron	7440-42-8	B	as boron trifluoride	2.2E-11	6.8E-10	9.3	6.7E-08	0.02	2.0E-04	175
Bromide	24959-67-9	No		2.2E-11	4.5E-10	NA	4.4E-08	NA	1.3E-04	NA
Cadmium	7440-43-9	AI,AII	Cd and compounds	2.2E-11	1.7E-11	0.00056	1.7E-09	None	4.9E-06	None
Calcium (from waste)	7440-70-2	B	as calcium hydroxide	2.2E-11	7.2E-07	17	7.0E-05	0.20	2.1E-01	1,750
Chloride	16887-00-6	No		2.2E-11	6.6E-08	NA	6.5E-06	NA	1.9E-02	NA
Chromium	7440-47-3	AI,AII	hexavalent compounds	2.2E-11	1.0E-09	0.000083	1.0E-07	None	3.0E-04	None
Cobalt	7440-48-4	No	(not present as metal dust or fume)	2.2E-11	5.6E-12	NA	5.5E-10	NA	1.6E-06	NA
Copper	7440-50-8	B	dusts and mists as Cu	2.2E-11	8.9E-10	3.3	8.7E-08	0.02	2.5E-04	175

Table A-3 – STU Emission Rates.

Constituent	CAS No.	TAP	TAP description	% of Influent Emitted % by mass	Stack Conc. ug/m3	ASIL ug/m3	Emission Hourly Rate[1] lb/hr	SQER lb/hr	Emission Rate[2] lb/yr	SQER lb/yr
Cyanide	57-12-5	B	as CN	2.2E-11	1.1E-11	17	1.1E-09	0.20	3.2E-06	1,750
Fluoride	16984-48-8	B	as F	2.2E-11	4.5E-09	8.3	4.4E-07	0.02	1.3E-03	175
Iron	7439-89-6	B	soluble salts as Fe	2.2E-11	1.1E-08	3.3	1.0E-06	0.02	3.0E-03	175
Lead	7439-92-1	AI,AIII	compounds	2.2E-11	5.9E-12	0.50	5.8E-10	None	1.7E-06	50
Magnesium	7439-95-4	No	(not present as a fume)	2.2E-11	1.2E-07	NA	1.2E-05	NA	3.5E-02	NA
Manganese	7439-96-5	B	compounds	2.2E-11	1.2E-10	0.40	1.2E-08	0.02	3.5E-05	175
Mercury	7439-97-6	B	inorganic compounds	2.2E-11	5.6E-13	0.33	5.5E-11	0.02	1.6E-07	175
Nickel	7440-02-0	AI,AII	Ni and compounds	2.2E-11	4.2E-10	0.0021	4.1E-08	None	1.2E-04	0.5
Nitrate	14797-55-8	B	nitric acid	2.2E-11	1.9E-06	17	1.9E-04	0.20	5.5E-01	1,750
Nitrite	14797-65-0	No		2.2E-11	1.3E-08	NA	1.3E-06	NA	3.9E-03	NA
Potassium	7740-09-7	B	as potassium hydroxide	2.2E-11	3.6E-08	6.7	3.6E-06	0.02	1.0E-02	175
Silicon	7440-21-3	No	(not present as silicon tetrahydride)	2.2E-11	2.7E-08	NA	2.7E-06	NA	7.8E-03	NA
Silver	7440-22-4	B	soluble compounds as Ag	2.2E-11	6.8E-12	0.033	6.7E-10	0.02	2.0E-06	175
Sodium	7440-23-5	B	as sodium hydroxide	2.2E-11	1.7E-07	6.7	1.6E-05	0.02	4.7E-02	175
Strontium	7440-24-6	No		2.2E-11	1.4E-09	NA	1.4E-07	NA	4.1E-04	NA
Sulfate	14808-79-8	B	sulfuric acid	2.2E-11	2.0E-06	3.3	1.9E-04	0.02	5.6E-01	175
Uranium	7440-61-1	B	soluble and insoluble	2.2E-11	1.8E-08	0.67	1.8E-06	0.02	5.3E-03	175
Vanadium	7440-62-2	B	as V2O5	2.2E-11	8.0E-11	0.17	7.8E-09	0.02	2.3E-05	175
Zinc	7440-66-6	No	(not present as a fume)	2.2E-11	3.7E-10	NA	3.6E-08	NA	1.1E-04	NA

[1] Hourly emission rate is based on the percent emitted from one Grout Mixer batch. The compound conversion factor in Table A-2 is applied.
[2] Annual emission rate is based one hour operation for each block, 8 blocks per day, 365 day operation.

Table A-4 - Emission during Pneumatic Transfers from Tanker Trucks to Storage Silos.

Tons of dry material used per year: 2200 tons per year[1]										
Dry Material:	Portland Cement					Blast Furnace Slag				
Proposed Composition of Blend:[2]	36.1%					36.1%				
Receipt, tons/day:[3]	38					25				
Receipt, tons/year:	794					794				
		Total PM:		Total PM10:			Total PM:		Total PM10:	
Emission Factor (EF), lb/ton:[4]		0.00099		0.00034			0.0089		0.0049	
Constituent	Wt %[5]	Emission Rate, lb/hr	Emission Rate, lb/yr	Emission Rate, lb/hr	Emission Rate, lb/yr	Wt %[5]	Emission Rate, lb/hr	Emission Rate, lb/yr	Emission Rate, lb/hr	Emission Rate, lb/yr
Total Emission Rate = Receipt * EF	--	1.6E-03	0.79	5.4E-04	0.27	--	9.3E-03	7.07	5.1E-03	3.89
Aluminum Oxide, Al2O3	4.2%	6.7E-05	0.033	2.3E-05	0.011	14.1%	1.3E-03	0.997	7.2E-04	0.549
Calcium Oxide, CaO	66.8%	1.0E-03	0.525	3.6E-04	0.180	42.2%	3.9E-03	2.984	2.2E-03	1.643
Iron Oxide, Fe2O3	3.5%	5.5E-05	0.028	1.9E-05	0.009	0.8%	7.4E-05	0.057	4.1E-05	0.031
Magnesium Oxide, MgO	1.0%	1.6E-05	0.008	5.4E-06	0.003	4.9%	4.5E-04	0.346	2.5E-04	0.191
Manganese Oxide, Mn2O3		0.0E+00	0.000	0.0E+00	0.000	0.5%	4.6E-05	0.035	2.6E-05	0.019
Silicon Dioxide, SiO2	21.3%	3.3E-04	0.167	1.1E-04	0.057	33.4%	3.1E-03	2.362	1.7E-03	1.300
Titanium Dioxide, TiO2		0.0E+00	0.000	0.0E+00	0.000	0.6%	5.6E-05	0.042	3.1E-05	0.023
Sodium Oxide, Na2O	0.4%	6.3E-06	0.003	2.2E-06	0.001	0.5%	4.6E-05	0.035	2.6E-05	0.019
Potassium Oxide, K2O		0.0E+00	0.000	0.0E+00	0.000	0.3%	2.8E-05	0.021	1.5E-05	0.012
Calcium Hydroxide, Ca(OH)2		0.0E+00	0.000	0.0E+00	0.000		0.0E+00	0.000	0.0E+00	0.000
Magnesium Hydroxide, Mg(OH)2		0.0E+00	0.000	0.0E+00	0.000		0.0E+00	0.000	0.0E+00	0.000
Calcium Carbonate, CaCO3		0.0E+00	0.000	0.0E+00	0.000		0.0E+00	0.000	0.0E+00	0.000
Sulfite, SO3	2.8%	4.4E-05	0.022	1.5E-05	0.008	1.9%	1.8E-04	0.134	9.7E-05	0.074
Sulphur, S		0.0E+00	0.000	0.0E+00	0.000	0.8%	7.4E-05	0.057	4.1E-05	0.031

Table A-4 - Emission during Pneumatic Transfers from Tanker Trucks to Storage Silos.

Tons of dry material used per year: 2200 tons per year[1]										
Dry Material:	Hydrated Lime					Totals				
Proposed Composition of Blend:[2]	27.8%					100.0%				
Receipt, tons/day:[3]	25					NA				
Receipt, tons/year:	611					2200				
		Total PM:		Total PM10:			Total PM:		Total PM10:	
Emission Factor (EF), lb/ton:[4]		0.0089		0.0049			NA		NA	
Constituent	Wt %[5]	Emission Rate, lb/hr	Emission Rate, lb/yr	Emission Rate, lb/hr	Emission Rate, lb/yr	Wt %[5]	Max Emission Rate, lb/hr	Total Emission, lb/yr	Max Emission Rate, lb/hr	Total Emission, lb/yr
Total Emission Rate = Receipt * EF	--	9.3E-03	5.44	5.1E-03	2.99	--	9.3E-03	13.3	5.1E-03	7.2
Aluminum Oxide, Al2O3	0.6%	5.7E-05	0.033	3.1E-05	0.018	6.8%	1.3E-03	1.064	7.2E-04	0.579
Calcium Oxide, CaO		0.0E+00	0.000	0.0E+00	0.000	39.4%	3.9E-03	3.509	2.2E-03	1.823
Iron Oxide, Fe2O3	0.2%	1.9E-05	0.011	1.0E-05	0.006	1.6%	7.4E-05	0.095	4.1E-05	0.047
Magnesium Oxide, MgO	1.1%	1.0E-04	0.061	5.7E-05	0.034	2.4%	4.5E-04	0.415	2.5E-04	0.227
Manganese Oxide, Mn2O3		0.0E+00	0.000	0.0E+00	0.000	0.2%	4.6E-05	0.035	2.6E-05	0.019
Silicon Dioxide, SiO2	1.1%	1.0E-04	0.061	5.7E-05	0.034	20.0%	3.1E-03	2.590	1.7E-03	1.391
Titanium Dioxide, TiO2		0.0E+00	0.000	0.0E+00	0.000	0.2%	5.6E-05	0.042	3.1E-05	0.023
Sodium Oxide, Na2O		0.0E+00	0.000	0.0E+00	0.000	0.3%	4.6E-05	0.038	2.6E-05	0.021
Potassium Oxide, K2O		0.0E+00	0.000	0.0E+00	0.000	0.1%	2.8E-05	0.021	1.5E-05	0.012
Calcium Hydroxide, Ca(OH)2	95.2%	8.8E-03	5.180	4.9E-03	2.852	26.5%	8.8E-03	5.180	4.9E-03	2.852
Magnesium Hydroxide, Mg(OH)2		0.0E+00	0.000	0.0E+00	0.000		0.0E+00	0.000	0.0E+00	0.000
Calcium Carbonate, CaCO3	1.7%	1.6E-04	0.093	8.7E-05	0.051	0.5%	1.6E-04	0.093	8.7E-05	0.051
Sulfite, SO3		0.0E+00	0.000	0.0E+00	0.000	1.7%	1.8E-04	0.156	9.7E-05	0.082
Sulphur, S		0.0E+00	0.000	0.0E+00	0.000	0.3%	7.4E-05	0.057	4.1E-05	0.031

[1] - Total quantity based on 1500 lbs dry material per block, 8 blocks per day, 365 days per year.

[2] - Composition of the blend is based on studies at Columbia Basin College.

[3] - Receipt per day is based on estimated tanker truck size (one truck batch per day).

[4] - Emission factors are from EPA, *Compilation of Air Emission Factors AP-42*, Volume I, Chapter 11, "Mineral Products Industry", Section 11.12, "Concrete Batching".

[5] - Makeup all compounds except hydrated* lime are from *Conceptual Design Report for Effluent Treatment Facility Solidification Treatment Unit*, HNF-26914, Rev 0, Fluor Hanford, Richland, WA. Hydrated lime compositon and bulk density from draft STU flowsheet, H-2-832777.

Table A-5 Emission during Pneumatic Transfers from Weigh Hoppers to Feed Hopper.

Tons of dry material used per year: 2200 tons per year[1]										
Dry Material:	Portland Cement					Blast Furnace Slag				
Proposed Composition of Blend:[2]	36.1%					36.1%				
Bulk Density, lb/ft3	87					75				
Weigh Hopper Size, ft3	8.0					8.0				
Receipt, tons/hr:[3]	0.35					0.30				
Receipt, tons/year:	794					794				
		Total PM:		Total PM10:			Total PM:		Total PM10:	
Emission Factor, lb/ton:[4]		0.00099		0.00034			0.0089		0.0049	
Constituent	Wt %[2]	Emission Rate, lb/hr	Emission Rate, lb/yr	Emission Rate, lb/hr	Emission Rate, lb/yr	Wt %[2]	Emission Rate, lb/hr	Emission Rate, lb/yr	Emission Rate, lb/hr	Emission Rate, lb/yr
Total Emission Rate = Receipt * EF	--	3.4E-04	0.79	1.2E-04	0.27	--	2.7E-03	7.07	1.5E-03	3.89
Aluminum Oxide, Al2O3	4.2%	1.5E-05	0.033	5.0E-06	0.011	14.1%	3.8E-04	0.997	2.1E-04	0.549
Calcium Oxide, CaO	66.8%	2.3E-04	0.525	7.9E-05	0.180	42.2%	1.1E-03	2.984	6.2E-04	1.643
Iron Oxide, Fe2O3	3.5%	1.2E-05	0.028	4.2E-06	0.009	0.8%	2.1E-05	0.057	1.2E-05	0.031
Magnesium Oxide, MgO	1.0%	3.4E-06	0.008	1.2E-06	0.003	4.9%	1.3E-04	0.346	7.2E-05	0.191
Manganese Oxide, Mn2O3		0.0E+00	0.000	0.0E+00	0.000	0.5%	1.3E-05	0.035	7.4E-06	0.019
Silicon Dioxide, SiO2	21.3%	7.3E-05	0.167	2.5E-05	0.057	33.4%	8.9E-04	2.362	4.9E-04	1.300
Titanium Dioxide, TiO2		0.0E+00	0.000	0.0E+00	0.000	0.6%	1.6E-05	0.042	8.8E-06	0.023
Sodium Oxide, Na2O	0.4%	1.4E-06	0.003	4.7E-07	0.001	0.5%	1.3E-05	0.035	7.4E-06	0.019
Potassium Oxide, K2O		0.0E+00	0.000	0.0E+00	0.000	0.3%	8.0E-06	0.021	4.4E-06	0.012
Calcium Hydroxide, Ca(OH)2		0.0E+00	0.000	0.0E+00	0.000		0.0E+00	0.000	0.0E+00	0.000
Magnesium Hydroxide, Mg(OH)2		0.0E+00	0.000	0.0E+00	0.000		0.0E+00	0.000	0.0E+00	0.000
Calcium Carbonate, CaCO3		0.0E+00	0.000	0.0E+00	0.000		0.0E+00	0.000	0.0E+00	0.000
Sulfite, SO3	2.8%	9.6E-06	0.022	3.3E-06	0.008	1.9%	5.1E-05	0.134	2.8E-05	0.074
Sulphur, S		0.0E+00	0.000	0.0E+00	0.000	0.8%	2.1E-05	0.057	1.2E-05	0.031

Table A-5 Emission during Pneumatic Transfers from Weigh Hoppers to Feed Hopper.

Tons of dry material used per year: 2200 tons per year[1]										
Dry Material:	Hydrated Lime					Totals				
Proposed Composition of Blend:[2]	27.8%					100.0%				
Bulk Density, lb/ft3	30					67				
Weigh Hopper Size, ft3	15.0					NA				
Receipt, tons/hr:[3]	0.23					0.87 <-- 1500 lbs/hr				
Receipt, tons/year:	611					2200				
		Total PM:		Total PM10:			Total PM:		Total PM10:	
Emission Factor, lb/ton:[4]		0.0089		0.0049			NA		NA	
Constituent	Wt %[2]	Emission Rate, lb/hr	Emission Rate, lb/yr	Emission Rate, lb/hr	Emission Rate, lb/yr	Wt %[2]	Emission Rate, lb/hr	Total Emission, lb/yr	Emission Rate, lb/hr	Total Emission, lb/yr
Total Emission Rate = Receipt * EF	--	2.0E-03	5.44	1.1E-03	2.99	--	5.0E-03	13.3	2.7E-03	7.2
Aluminum Oxide, Al2O3	0.6%	1.2E-05	0.033	6.7E-06	0.018	6.8%	4.0E-04	1.064	2.2E-04	0.579
Calcium Oxide, CaO		0.0E+00	0.000	0.0E+00	0.000	39.4%	1.4E-03	3.509	7.0E-04	1.823
Iron Oxide, Fe2O3	0.2%	4.0E-06	0.011	2.2E-06	0.006	1.6%	3.7E-05	0.095	1.8E-05	0.047
Magnesium Oxide, MgO	1.1%	2.2E-05	0.061	1.2E-05	0.034	2.4%	1.6E-04	0.415	8.6E-05	0.227
Manganese Oxide, Mn2O3		0.0E+00	0.000	0.0E+00	0.000	0.2%	1.3E-05	0.035	7.4E-06	0.019
Silicon Dioxide, SiO2	1.1%	2.2E-05	0.061	1.2E-05	0.034	20.0%	9.9E-04	2.590	5.3E-04	1.391
Titanium Dioxide, TiO2		0.0E+00	0.000	0.0E+00	0.000	0.2%	1.6E-05	0.042	8.8E-06	0.023
Sodium Oxide, Na2O		0.0E+00	0.000	0.0E+00	0.000	0.3%	1.5E-05	0.038	7.8E-06	0.021
Potassium Oxide, K2O		0.0E+00	0.000	0.0E+00	0.000	0.1%	8.0E-06	0.021	4.4E-06	0.012
Calcium Hydroxide, Ca(OH)2	95.2%	1.9E-03	5.180	1.1E-03	2.852	26.5%	1.9E-03	5.180	1.1E-03	2.852
Magnesium Hydroxide, Mg(OH)2		0.0E+00	0.000	0.0E+00	0.000		0.0E+00	0.000	0.0E+00	0.000
Calcium Carbonate, CaCO3	1.7%	3.4E-05	0.093	1.9E-05	0.051	0.5%	3.4E-05	0.093	1.9E-05	0.051
Sulfite, SO3		0.0E+00	0.000	0.0E+00	0.000	1.7%	6.0E-05	0.156	3.1E-05	0.082
Sulphur, S		0.0E+00	0.000	0.0E+00	0.000	0.3%	2.1E-05	0.057	1.2E-05	0.031

[1] - Total quantity based on 1500 lbs dry material per block, 8 blocks per day, 365 days per year.

[2] - See previous table for basis of dry material composition.

[3] - Receipt per hour is based on one weigh hopper from each silo per hour.

[4] - Emission factors are from EPA, Compilation of Air Emission Factors AP-42, Volume I, Chapter 11, "Mineral Products Industry", Section 11.12, "Concrete Batching".

[5] - Since more than one weigh hopper batch can occur in an hour, the hourly emission rate is the sum of the rate of each material.

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ENCLOSURE 2

Notification of Off-Permit Change

HANFORD SITE AIR OPERATING PERMIT

NOTIFICATION OF OFF-PERMIT CHANGE
Permit Number: 00-05-006 Renewal 1

This notification is provided to Washington State Department of Ecology, Washington State Department of Health, and the U.S. Environmental Protection Agency as a notice of an off-permit change described as follows.

This change is allowed pursuant to WAC 173-401-724(1), WAC 173-401-724(2), and WAC 173-401-724(6):
1. Change is not specifically addressed or prohibited by the permit terms and conditions,
2. Change does not weaken the enforceability of the existing permit conditions,
3. Change is not a Title I modification or a change subject to the acid rain requirements under Title IV of the FCAA,
4. Change meets all applicable requirements and does not violate an existing permit term or condition,
5. Change has complied with applicable preconstruction review requirements established pursuant to RCW 70.94.152.

Provide the following information pursuant to WAC-173-401-724(3):

Description of the change:
A solidification treatment unit (STU) will be added to the 200 Area Effluent Treatment Facility. This change will result in new emission points from the dry material storage silo vents and a new exhaust stack for the STU addition. Each of the three silos will be vented to the atmosphere through filtration units located on top of each silo. The STU exhaust stack system will consist of two exhaust trains, one in service, one backup. Each train will have a prefilter, two high-efficiency particulate air (HEPA) filters arranged in series, and an exhauster.
Date of Change: (To be provided in the agency approval order.)
Describe the emissions resulting from the change:
Dry emissions levels are shown in the attached Table 1. All rates are below the SQER values. STU exhaust emission levels are shown in the attached Table 2. All rates are below the SQER and ASIL values.
Describe the new applicable requirements that will apply as a result of the change: (To be provided in the agency approval order.)

For Hanford Use Only:	
AOP Change Control Number:	Date Submitted:

Table 1. Dry Material Emissions.

Constituent	Total PM		Total PM10		WAC 173-460 Levels	
	Emission Rate, lb/hr[1]	Emission Rate, lb/yr[2]	Emission Rate, lb/hr[1]	Emission Rate, lb/yr[2]	SQE Rate, lb/hr	SQE Rate, lb/yr
Aluminum Oxide, Al2O3	1.3E-03	2.13	7.2E-04	1.16	Not present as a fume	
Calcium Oxide, CaO	3.9E-03	7.02	2.2E-03	3.65	2.0E-02	175
Iron Oxide, Fe2O3	7.4E-05	0.19	4.1E-05	0.09	Not present as a fume	
Magnesium Oxide, MgO	4.5E-04	0.83	2.5E-04	0.45	Not present as a fume	
Manganese Oxide, Mn2O3	4.6E-05	0.07	2.6E-05	0.04	2.0E-02	175
Silicon Dioxide, SiO2	3.1E-03	5.18	1.7E-03	2.78	NA	NA
Titanium Dioxide, TiO2	5.6E-05	0.08	3.1E-05	0.05	NA	NA
Sodium Oxide, Na2O	4.6E-05	0.08	2.6E-05	0.04	NA	NA
Potassium Oxide, K2O	2.8E-05	0.04	1.5E-05	0.02	NA	NA
Calcium Hydroxide, Ca(OH)2	8.8E-03	10.4	4.9E-03	5.70	2.0E-01	1750
Calcium Carbonate, CaCO3	1.6E-04	0.19	8.7E-05	0.10	NA	NA
Sulfite, SO3	1.8E-04	0.31	9.7E-05	0.16	NA	NA
Sulphur, S	7.4E-05	0.11	4.1E-05	0.06	NA	NA
Total vs PM and PM10						
	Total PM		Total PM10		WAC 173-400 Levels	
		Emission Rate, lb/yr[2]		Emission Rate, lb/yr[2]	Total PM, lb/yr	Total PM10, lb/yr
Particulate Matter	NA	26.6	NA	14.3	2500	1500

[1] Since silos would not be filling and discharging at a time, the lb/hr is the maximum value of any one transfer.

[2] Sum of emissions from all silos.

Table 2. Summary of Emission from STU Exhaust.

Constituent	TAP	TAP description	Influent Waste Conc[a] mg/L (ppm)	Emission			WAC 173-460 Level		
				Stack Exhaust Conc. ug/m^3	Emission Rate[b] lb/hr	Emission Rate[c] lb/yr	ASIL Conc. ug/m^3	SQE Rate lb/hr	SQE Rate lb/yr
1,1,1-Trichloroethane (Methyl chloroform)	B		0.00073	2.9E-06	7.1E-11	2.1E-07	6400	5.0	43,748
1,1,2-Trichloroethane	B		0.00031	3.1E-06	7.5E-11	2.2E-07	180	2.6	22,750
1,2-Dichloroethane	B		0.00011	1.5E-06	3.6E-11	1.1E-07	2700	5.0	43,748
1,4-Dichlorobenzene	AI,AI I		0.0001	2.1E-06	5.2E-11	1.5E-07	1.5	None	500
1-Butanol (n-Butyl alcohol)	B		11	5.8E-02	1.4E-06	4.2E-03	500	5.0	43,748
2-Butanone (Methyl ethyl ketone)	B		0.053	5.7E-04	1.4E-08	4.1E-05	1000	5.0	43,748
2-Butoxyethanol	B		0.4	2.2E-03	5.4E-08	1.6E-04	400	5.0	43,748
4,4'-DDE	AI,AI I		0.00032	1.8E-06	4.3E-11	1.3E-07	0.10	None	20
4,4'-DDT	AI,AI I		0.0042	5.0E-05	1.2E-09	3.6E-06	0.01	None	10
Acetone	B		1.0	2.3E-02	5.6E-07	1.6E-03	5900	5.0	43,748
Aldrin	AI,AI I		0.0018	2.1E-05	5.2E-10	1.5E-06	0.0002	None	--
Benzene	AI,AI I		0.002	1.5E-05	3.6E-10	1.0E-06	0.12	None	20
Carbon tetrachloride	AI,AI I		0.44	7.7E-04	1.9E-08	5.5E-05	0.067	None	10
Chloroform	AI,AI I		0.014	8.8E-05	2.2E-09	6.3E-06	0.043	None	10
Dieldrin	AI,AI I		0.0038	4.5E-05	1.1E-09	3.2E-06	0.00022	None	None
Dodecane	No		100	8.1E-04	2.0E-08	5.8E-05	NA	NA	NA
Endrin	B		0.0044	2.4E-05	6.0E-10	1.7E-06	0.33	0.02	175
Endrin aldehyde	No		0.00067	3.7E-06	9.1E-11	2.6E-07	NA	NA	NA
Ethyl benzene	B		0.0009	6.9E-06	1.7E-10	4.9E-07	1000	5.0	43,748

Table 2. Summary of Emission from STU Exhaust.

Constituent	TAP	TAP description	Influent Waste Conc[a] mg/L (ppm)	Emission			WAC 173-460 Level		
				Stack Exhaust Conc. ug/m^3	Emission Rate[b] lb/hr	Emission Rate[c] lb/yr	ASIL Conc. ug/m^3	SQE Rate lb/hr	SQE Rate lb/yr
gamma-BHC (Lindane) (Hexachlorocyclohexane)	AI,AII		0.0017	1.8E-05	4.4E-10	1.3E-06	1.7	None	500
Heptachlor	AI,AI		0.0017	2.4E-05	6.0E-10	1.7E-06	0.00077	None	None
m-Cresol (Cresol, all isomers)	B		0.074	3.2E-04	7.9E-09	2.3E-05	73	1.20	10,500
Methyl isobutyl ketone	B		0.014	2.0E-04	5.0E-09	1.5E-05	680	5.0	43,748
Methyl n-butyl ketone (2-Hexanone)	B		0.014	2.1E-04	5.1E-09	1.5E-05	67	1.20	10,500
Methyl n-propyl ketone (2-Pentanone)	B		0.0097	1.4E-04	3.5E-09	1.0E-05	2300	5.0	43,748
Methylene chloride (Dichloromethane)	AI,AI		0.14	8.6E-04	2.1E-08	6.2E-05	0.56	None	50
Pentachlorophenol	AI,AI		0.027	1.5E-04	3.6E-09	1.1E-05	0.33	None	50
Phenol	B		0.84	5.2E-03	1.3E-07	3.7E-04	63	1.20	10,500
Tetrachloroethene (Perchloroethylene)	AI,AI		0.00062	1.2E-06	2.8E-11	8.2E-08	1.1	None	500
Tetradecane	No		0.18	9.1E-06	2.2E-10	6.5E-07	NA	NA	NA
Tetrahydrofuran	B		0.039	3.7E-04	9.0E-09	2.6E-05	2000	5.0	43,748
Toluene	B		0.0006	3.0E-06	7.4E-11	2.2E-07	400	5.0	43,748
Tributyl phosphate	No		30	1.6E-01	4.0E-06	1.2E-02	NA	NA	NA
Trichloroethene	AI,AI		0.008	3.0E-05	7.3E-10	2.1E-06	0.59	None	50
Xylenes (total)	B		0.0016	9.2E-06	2.2E-10	6.6E-07	1500	5.0	43,748
Ammonium	B	as ammonia	511	7.5E+04	1.8	5,400	100	2.0	17,500
Aluminum	B	Al soluble salts as	1.33	1.2E-08	1.2E-06	3.4E-03	6.7	0.02	175

Table 2. Summary of Emission from STU Exhaust.

Constituent	TAP	TAP description	Influent Waste Conc[a] mg/L (ppm)	Emission			WAC 173-460 Level		
				Stack Exhaust Conc. ug/m^3	Emission Rate[b] lb/hr	Emission Rate[c] lb/yr	ASIL Conc. ug/m^3	SQE Rate lb/hr	SQE Rate lb/yr
		aluminum nitrate							
Antimony	B	compounds as Sb	0.1	1.1E-10	1.1E-08	3.2E-05	1.7	0.02	175
Barium	B	soluble compounds as Ba	0.3	3.4E-10	3.3E-08	9.6E-05	1.7	0.02	175
Beryllium	AI,AI I	Be and compounds	0.0019	3.1E-11	3.1E-09	9.0E-06	0.00042	None	None
Boron	B	as boron trifluoride	0.097	6.8E-10	6.7E-08	2.0E-04	9.3	0.02	175
Bromide	No		0.4	4.5E-10	4.4E-08	1.3E-04	NA	NA	NA
Cadmium	AI,AI I	Cd and compounds	0.0072	1.7E-11	1.7E-09	4.9E-06	0.00056	None	None
Calcium	B	as calcium hydroxide	330	7.2E-07	7.0E-05	2.1E-01	17	0.20	1,750
Chloride	No		59	6.6E-08	6.5E-06	1.9E-02	NA	NA	NA
Chromium	AI,AI I	hexavalent compounds	0.18	1.0E-09	1.0E-07	3.0E-04	0.000083	None	None
Cobalt	No	(not present as metal dust or fume)	0.005	5.6E-12	5.5E-10	1.6E-06	NA	NA	NA
Copper	B	dusts and mists as Cu	0.79	8.9E-10	8.7E-08	2.5E-04	3.3	0.02	175
Cyanide	B	as CN	0.01	1.1E-11	1.1E-09	3.2E-06	17	0.20	1,750
Fluoride	B	as F	4	4.5E-09	4.4E-07	1.3E-03	8.3	0.02	175
Iron	B	soluble salts as Fe	9.4	1.1E-08	1.0E-06	3.0E-03	3.3	0.02	175
Lead	AI,AI II	compounds	0.0033	5.9E-12	5.8E-10	1.7E-06	0.50	None	50
Magnesium	No	(not present as a fume)	110	1.2E-07	1.2E-05	3.5E-02	NA	NA	NA
Manganese	B	compounds	0.033	1.2E-10	1.2E-08	3.5E-05	0.40	0.02	175
Mercury	B	inorganic compounds	0.00031	5.6E-13	5.5E-11	1.6E-07	0.33	0.02	175
Nickel	AI,AI I	Ni and compounds	0.12	4.2E-10	4.1E-08	1.2E-04	0.0021	None	0.5
Nitrate	B	nitric acid	1700	1.9E-06	1.9E-04	5.5E-01	17	0.20	1,750

Table 2. Summary of Emission from STU Exhaust.

Constituent	TAP	TAP description	Influent Waste Conc[a] mg/L (ppm)	Emission			WAC 173-460 Level		
				Stack Exhaust Conc. ug/m^3	Emission Rate[b] lb/hr	Emission Rate[c] lb/yr	ASIL Conc. ug/m^3	SQE Rate lb/hr	SQE Rate lb/yr
Nitrite	No		12	1.3E-08	1.3E-06	3.9E-03	NA	NA	NA
Potassium	B	as potassium hydroxide	13	3.6E-08	3.6E-06	1.0E-02	6.7	0.02	175
Silicon	No	(not present as silicon tetrahydride)	24	2.7E-08	2.7E-06	7.8E-03	NA	NA	NA
Silver	B	soluble compounds as Ag	0.0061	6.8E-12	6.7E-10	2.0E-06	0.033	0.02	175
Sodium	B	as sodium hydroxide	59	1.7E-07	1.6E-05	4.7E-02	6.7	0.02	175
Strontium	No		1.27	1.4E-09	1.4E-07	4.1E-04	NA	NA	NA
Sulfate	B	sulfuric acid	1398	2.0E-06	1.9E-04	5.6E-01	3.3	0.02	175
Uranium	B	soluble and insoluble	16.4	1.8E-08	1.8E-06	5.3E-03	0.67	0.02	175
Vanadium	B	as V2O5	0.04	8.0E-11	7.8E-09	2.3E-05	0.17	0.02	175
Zinc	No	(not present as a fume)	0.33	3.7E-10	3.6E-08	1.1E-04	NA	NA	NA

[a] Influent waste concentrations are the maximum values from:
- Appendix A of *Notice for Approval of Construct the 242-A Evaporator/PUREX Plant Process Effluent Treatment Facility* (DOE/RL-92-69, Rev 0). Concentrations are for 242-A Evaporator process condensate.
- Table 2 of *Nonradioactive Air Emissions Modification to the Notice of Construction for the 200 Area Effluent Treatment Facility* (DOE/RL-96-78, Rev 0.)

Influent concentrations are based on the influent being routed directly to Secondary Waste Receiving Tanks (SWRTs).

[b] Hourly emission rate is based on the percent emitted from one Grout Mixer batch. The compound conversion factor in Table B-2 is applied.

[c] Annual emission rate is based one hour operation for each block, 8 blocks per day, 365 day operation.